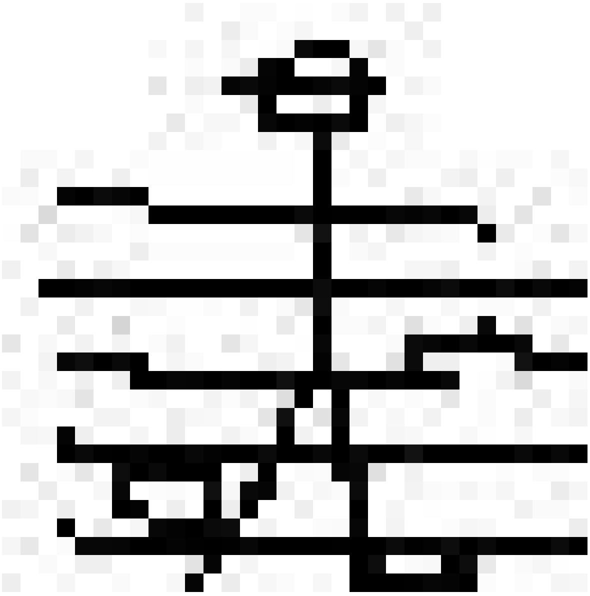
Towards an Aesthetics of Cognitive-Parametric Music



Busevin

Towards an Aesthetics of Cognitive-Parametric Music

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To Lua In Memoriam

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Foreword Translation

A few words are needed to explain how certain things, that were announced, have evolved since the book was originally written. The promise of a new chapter regarding the new parametric materials has developed since the book's end, as outlined in several papers. The works that followed the studies, *Cognitive Dissonance*, *Three Chants for Computer* and *Homo Homini Lupus,* were debuted in conferences. The two papers, *Using Cognitive Models and Formalizing the Temporal-space Relativity in Parametric Music and its Algorithmic Treatment in Max/Msp* and *Intrasensory Synaesthesia in Musical Composition,* were presented at those conferences and include the new material that symbolized a new chapter in my research. In the paragraph concerning the parameter concept as musical material, I announced a new work with a FOF parametric system. This was originally intended for *Three Chants for Computer*, but it took on a life of its own, becoming the embryo for *Cognitive Dissonance*. In this way, the two components of de the FOF parametric system were split. The algorithm I ultimately used in *Cognitive Dissonance* was originally going to be a movement of *Three Chants for Computer*, but I realized that it was entirely separate work. Finally, I decided to use a phase vocoder synthesis engine instead of the FOF system. After I finalized *Cognitive Dissonance*, the FOF engine was used in the second movement as it was in the third movement of *Three Chants for Computer*. In *Homo Homini Lupus*, the formal model of *Cognitive Dissonance* and the FOF engine are integrated.

The book is very similar to the original version, except with the addition of this foreword translation. I also inserted a section in chapter 8 titled, *Modelization of Cognitive-Parametric music*, and wrote a new introduction chapter based on several divulgation-like style texts I made after finishing this book. You can find my latest writings at http://busevin.art. Please check this web site periodically for new materials and works. In case of any divergence in interpretation between the English version and the original book, a thorough consultation of the first version is mandatory. I have also changed the title of the book since the original text. I find that deciding upon names and terminology is one of the most difficult tasks for me. I was never comfortable with the term “parametric music,” so I have changed it to “cognitive-parametric music”; however, I remain dubious about my decision. In any case, it is not the label but rather the idea that is most important to the reader. If I were to write the entire book now, I would do so in a very different manner, quoting several different authors. I have likely overexplained concepts in some sections of the book, even when it was possible, or even better, to explain things more clearly. However, I think that it is important to keep the book’s original integrity for this translated version, as it reflects how I conceived of the ideas and thoughts in the moment they were created.

May 2020

Foreword

This book was born as a series of writings, including the substantial notes, jottings, critical comments, and brief analyses that I have made throughout my creative process. These texts started when I was composing *Parametric Modulations Studies*, and I realized the possibility of compiling them in a book when I finished writing *Parametric Formalizations Studies*. There was a great deal of time between these two moments, so my compositional duties (i.e., checking my progress to know how to proceed, finding inspirational clues, and taking notes to restart the piece) kept me busy. My notes acted as a script, helping me finish the project. When I started writing *Parametric Formalizations Studies,* I reviewed the text in its entirety in order to assess its readability and clarity. In 2009, I arranged it in its current format and published it when *Parametric Modulations Studies* was premiered.

Once I completed *For Rachel Corrie* in 2006, I realized I needed to stop and reconsider my direction. I soon realized that my work needed to endure a maturation process in order to move forward.

Rather than continue writing, I stopped altogether and entered a period of reflexivity. This somehow led to my first dissertation about music titled, *An introduction to Parametric Music. Why to Compose Music?*

I began rethinking this particular text to discover new ideas that could lead to *Parametric Formalizations Studies.* While writing this composition, I decided to actively analyse the piece as I wrote it in order to avoid the kinds of problems I had with my previous two works, when I had to constantly reanalyze what I had just composed every time I restarted work on the piece.

Therefore, the text you are holding right now is “a work in progress,” unfinished, and raw; it does not intend to reveal all of the answers as a complete epistemology, but instead to display the status of the knowledge as it was when it was first written.

The day that Prometheus gave the gift of the word, he passed around my house without knocking on the door; however, even for those who do not identify as writers, the process of writing is like breathing. It is like talking aloud to oneself, which is why my main purpose for writing this book is to convey the content, with less concern for the form in which it is presented.

This text does not try to prove anything; I simply explain the process and the context in which a series of creations have taken place, attempting to show the thinking that lies behind these creations. This text is not intended to validate a comprehensive understanding of music composition, but rather provides an explanation of my music and its place within the fields of art, aesthetics, music philosophy, and music sociology, and its relationship with politics. I make an effort to explain how various concepts from these fields have been applied, treated, and used in my pieces. Artistic activity creates new phenomena and contributes to the formation of new knowledge. This text intends to explain a set of new compositional ideas that have many qualities in common with one another. Those who acknowledge the limitations of human stupidity and fanaticism tend to believe that he who maintains a thesis is an enemy of the other; however, that is not the case in this book.

I certainly do not intend to normalize or legislate any one theory, nor do I believe that cognitive-parametric music has the right to exist anymore than another style. That is why I'm going to talk in terms of *an* approach, instead of *the* approach. Having stated my principles clearly and openly, I hope this statement sheds some light on my writing and prevents the need to mention within every section.

Indeed, this sense of absolute freedom must be established, as freedom is something too difficult to obtain, yet far too easy to lose in the field of creation, especially in these current times when it is so threatened by the dictatorship of the market.

Cognitive-parametric music comprises a large number of concepts and ideas from different fields of human knowledge such as semiotics, philosophy, and sociopolitical models (as we see, the idea of music without a center starts from a socio-political model interpreted from a philosophical perspective), as well as from cognitive neuroscience, cognitive science, and physics (e.g., the Doppler Effect, Theory of Relativity, and Information Theory). The artists are inserted in this changing world and cannot remain oblivious to the things that are happening all around him.

All sorts of thoughts and ways of thinking have been a source of inspiration for the composer, so the artist can take such concepts provided by other fields of knowledge. However, I do not pretend to found cognitive-parametric music solely on any of these fields of knowledge. The book is not about creating isomorphic structures, but about breaking rules. Furthermore, my music doesn't imitate nature; it seeks to deconstruct what we think of as "normal." I want to completely pull down false centers on which we have been told or convinced to settle our absurd lives.

Cognitive-parametric music is constructed from forms and strictly musical concepts, all of which were created from traditional musical materials that have been restated and abstracted from their dependence on a particular parameter. As I have mentioned before, one cannot be unaware of the world in which we live. These works have been created in a world of great injustice, representing a revolt against this environment. Mankind does not know how to live with itself or with other species. This sentiment thus motivates me, reflecting my desire to contribute to a better world by creating new phenomena in the field of music and its perception. It is my hope that they inspire people to pursue alternate worldviews and to believe that it is possible to see the world from a different point of view that does not align with the manipulated perspective of the system. The rules that currently govern the relationship among humans and their environment are only one posibility, and it is essential for the survival of our species and others on the Earth that they change. Thus, cognitive-parametric music does not part from naturalist aesthetics as an imitation of nature, but rather emerges as a kind of cognitive mirror through which society will see its ugliness reflected. Despite my abstract explanations of all these extra-musical matters, and although the music's meaning comes from, like everything else, its context, the most important issue of music or sound art *remains* the music or sound art.

Extramusical ideas inevitably raise new musical challenges. Each of these works has been proposed as a solution to specific musical problems derived from the previously mentioned challenges, such as how to make a parametric modulation or how to make a sound flow without any parametric centrality. To change the way in which mankind sees itself is to change the world; I trust that changing the algorithms that puzzle us or give shape to what we consider to be our "reality" will allow us to see the world in a different way.

Apart from showing my point of view as a composer, I would also like to discuss other composers who had a great influence on me and my work.

I owe a large debt to two philosophers in particular: Adorno and Sartre. I quote Adorno more often because of his prolific writings on art, aesthetics, and music, but my own philosophies align more closely to Sartre's, so much so that I sometimes find difficult to differentiate my own ideas from his. You could even go so far as to say that all of this book embodies the greatest of Sartre's theories. It is from him that I learned how everything is pure illusion, and that we are just a lack of being, hence my obsession to substantiate the work from the void, lacking any center. I also learned, through the reading of *Critique of Dialectical Reason,* how to critically examine the paradigms of progress, i.e., the paradigms that are folded in on themselves and are not easily investigated from the outside.

As far as I know, the first composer who used the term "parametric" to define his music was Clarence Barlow. Although our compositional endeavors have similarities, his concept is different from mine: we call parametric music two different things. As I have mentioned before, and what will become clear throughout the book, is that cognitive-parametric music, from my perspective, uses the concept of parameter as a musical material, which Barlow refers to as algorithmic music. Barlow classifies his production within four types of music, of which parametric is one; the other three ones are linguistics, derivative, and commentative. In reference to the parametric type, he writes:

> I. Parametric Music: Concerning the algorithmic control of music by means of various parameters, mainly tonality and metricism (this needed research into the world of numbers). (Quoted from http://users.skynet.be/P-ART/P-ARTWEB/1BARLOW/BARLOW.htm)

For those who want to know more about this interesting composer I recommend the following links:

http://users.skynet.be/P-ART/P-ARTWEB/1BARLOW/BARLOW.htm
http://www.culturebase.net/artist.php?1568
http://en.wikipedia.org/wiki/Clarence_Barlow
http://www.paristransatlantic.com/magazine/interviews/barlow.html

It is essential that I openly acknowledge the influence of the composers who not only made me experience music in a totally new way, changing my perception of reality entirely, but also provided me with so many acute musical experiences that had a significant impression on my own compositional style. These composers are Scelsi, Ligeti, Grisey and Feldman, and, above all of them and more than any other, Luigi Nono.
From these five individuals, I have learned the way in which a material can have multiple dimensions. They taught me how to neutralize parameters and how to set sound speeches based on structures of patterns, as well as the special domain of time as musical material that goes beyond the rhythm or the structures of durations. I should also state here the direct influence of Schoenberg, which is perhaps astonishing, considering that the height of his career was so long ago. It was Schoenberg that influenced me, not only indirectly, because of his influence on later composers. But Schoenberg has also affected me directly; I am in his debt for being the first to compose with parametric materials (timbre melody) and for his deep reflections on the significance of sound objects, which certainly influenced the works of Nono and Stockhausen. Other composers such as Xenakis, Reich, Spahlinger, Stockhausen, Lachenmann, Sciarrino, Varèse, Schaeffer, Cage, Murail, Dodge, Carter, Risset, and Stravinsky were also impactful on my work. All, in some way or another, have contributed to my understanding of cognitive-parametric music.

I also want to clarify that cognitive-parametric music is not a method of composition; rather, it tries to explain, from the perspective of the author, a form of composing that sometimes exhausts itself and other times moves in multiple developing ways. Therefore, rather than speaking about a method of composition as a closed and static matter, I prefer to talk about concrete techniques as an open and constantly evolving matter.
In regard to the opinions and comments made about the composers who have influenced me, I must clarify that I mostly speak to the ways in which they have influenced me. It is not my intention to represent the whole of their work and theories in this book.
Finally, I'd like to thank Matías Far and Javier Castro, who brought my first two studies to life via sound. Without their support, *Parametric Formalizations Studies* would have remained an idea floating away in a

few of my neurons, and this book would have never seen the light of day. They had the courage to appreciate the potential of these works before anyone else. Certainly, I must also mention my appreciation for those who have often patiently listened to me talk about parametric music, most notably Matías Far, Alberto Hortigüela, Emiliano del Cerro and José Luis de Delás. I've learned from José Luis the importance of gestures in music; from Emiliano that music must breathe; and from Matías and Alberto that the most important thing in life is to move into a dustbin. Thanks to all of them, as well as to Javier Castro, Miguel Rubio, and Alex Mogly for their friendship and constant dialogue. And, of course and above all, to Lua, my greatest source of inspiration and to whom this book is dedicated.

January 2012
Rev 3.1 August 2015

1. Introduction to cognitive-parametric music

The best way to explain something is by making a comparison to another, more familiar, area. With this in mind, I want to begin by explaining cognitive-parametric music through a very different sense of hearing: the sense of taste.

All of us have, at one time or another, enjoyed this simple experiment. If you drink a glass of sweetened milk, it tastes sweet. If the next day you eat a piece of toast with jam and then drink a glass of milk, you will realize the glass of milk no longer tastes sweet – it tastes different. We might even say that it tastes more bitter. However, the milk is the same. If we apply this experiment to sound, it is what we name cognitive-parametric music. In parametric music jargon, this phenomenon is called parametric neutralization.

The fundamental idea of the cognitive-parametric approach is that the meaning of the materials that form artistic works is relative to the context (as we'll see with the parametric context) instead of being determined by its own objective qualities as an entity.

Another example, this time taken from the visual world, would be to view a graph through a color filter. If we see a graph through a blue filter, the blue color remains undifferentiated (i.e., meaningless and neutralized in parametric jargon), and equal to white colors. Now compare this paradox that a color is undifferentiated when it is observed with a filter of the same color. This paradox, when applied to sound, is another foundation of the cognitive-parametric approach. We can thus derive from these examples a basic cognitive rule. If we eat two foods, we tend to ignore (or neutralize) what is the same in both, instead focusing our attention on what is different. This rule is the foundation of parametric neutralizations and, hence, of parametric modulations. Intuitively, we can understand that if we present a series of objects that have the same sound or taste, its meaning is related to the differences between them, contrasting with respect to the previous one. We only perceive what differentiates them, staying meaningless (or neutralized) in regard to what they have in common.

To put it simply: an object (a glass of milk) tastes different (or means something different in the cognitive-parametric music terminology) according to the context.

Cognitive-parametric music is based on the idea that the importance of musical events depends not on its physical objective properties but on its significance. And, in turn, this significance is relative to the way in which the interaction of some parameters with each other determines their meaning in a particular cognitive system.

So far, we have only considered a single parameter, but what happens when several parameters (properties) interact?

I will explain this idea slowly. Milk is an object that has the ability to be more or less sweet than other foods. "Sweetness" is a parameter (or property) of food. We have seen that if two foods with different sweetness levels are ingested, the second one is seemingly less sweet than it actually is (i.e., a form of parametric neutralization). But what happens if we define additional properties of foods and see how their interaction influences their significance?

Let's consider several properties of food as parameters, such as bitterness, temperature, and spiciness. If we make very spicy food, the sweetness will be masked. If we try a very spicy food, any other thing we eat afterwards will lose its flavor (i.e., it will lose the signification) and be meaningless in regard to the spicy context. Thus, the significance of certain properties is conditioned by others; in this case, the significance of sweetness is conditioned by the spiciness. The significance of a property is relative to another; in the context of the cognitive-parametric approach, the significance of the process that occurs in a parameter depends on the process that happens in another parameter.

Furthermore, each type of cuisine can be defined by a central parameter that determines the other guidelines. In Mexican cuisine, for example, spiciness is prioritized overall.

So far, we still have not made any progress regarding the nonparametric conception. Studying these creative metaphors in such a way, however, leads to an important question, which until now had not been answered, and is the fundamental question for the cognitive-parametric music: Is it really necessary for a central parameter to determine the significance of the other parameters all the time?

Cognitive-parametric music generates a musical discourse in which there is not any central parameter. We have seen that there are different types of cuisines, each based on a single central property; they can be based on the spiciness (Mexican), sweetness (pastries), or bitterness (Chinese) of the food. What differentiates a parametric cuisine from a nonparametric one is the equal importance of all properties in the former, whereas the latter contains a hierarchy of parameters in which a certain parameter is dominant.

Thus, cognitive-parametric music is characterized by the fact that there is no central or dominant parameter that determines the sound stream. For example, in tonal music, the pitches are the central parameter; the structure of a tonal work specifies how a departure from the original key generates tension, which then relaxes when the piece returns to the original key. In nonparametric music on the other hand, tension is associated with the characteristics of a particular parameter. In Xenakis´ stochastic music, for example, a sense of tension and relaxation is produced by increasing and decreasing the densities of sound masses. In general, the tension of a work is produced through the concept of dissonance that is associated with a given parameter.

In tonal music, tension is produced by certain dissonant intervals like the second, the tritone, and the seventh. In masses music, dissonance occurs through the superposition of events. The tension in the musical processes occurs in a way that is relative to the parameter or property that dominates the others. However, there is some music, such as Cage´s chance one, that does not consider tensioning processes, but cognitive-parametric music comes before this need to liberate tensioning processes from the work's qualities that are associated with a particular property or parameter of musical materials. For this purpose, it was necessary to avoid the dominance of any parameter over the other ones. The research process ultimately revealed that this could be accomplished by the creation of a series of parametric materials such as the scale of parameters which, unlike traditional musical materials, are not related to a particular parameter. This process bore a series of new music materials based on the concept of parameter, which is then used to create cognitive-parametric music.

By separating traditional materials from their dependence on a property or parameter of sound, the tensioning process can also become disassociated with a particular parameter. Therefore, cognitive-parametric music tensioning is based on the idea of cognitive dissonance rather than dissonance associated with a type of material based on a parametric centrality. Cognitive dissonance and cognitive tension are based on processes of tension and relaxation that occur as a result of the listener’s ability to recognize certain patterns or regularities or to predict what is going to happen. When the association of the tension with an object’s property is relatively objective, as is the case in cognitive-parametric music, then the tensioning depends on the cognitive processes produced in the listener’s brain, and therefore the public can freely interpret the music.

Cognitive-parametric music’s ultimate purpose is to release the public from the composer’s intentions. It is a solution to the problem of how to ensure that the public can be an integral part of the artistic magic. Cognitive-parametric music achieves this through a few materials whose tension is dependent on the cognitive processes that occur during listening rather than on a parametric centrality, allowing the listener to invent his own meaning of the work since the act of listening is a cognitive process that is not associated with the author’s intentions. Other composers have tried other strategies, like Cage through total randomness.

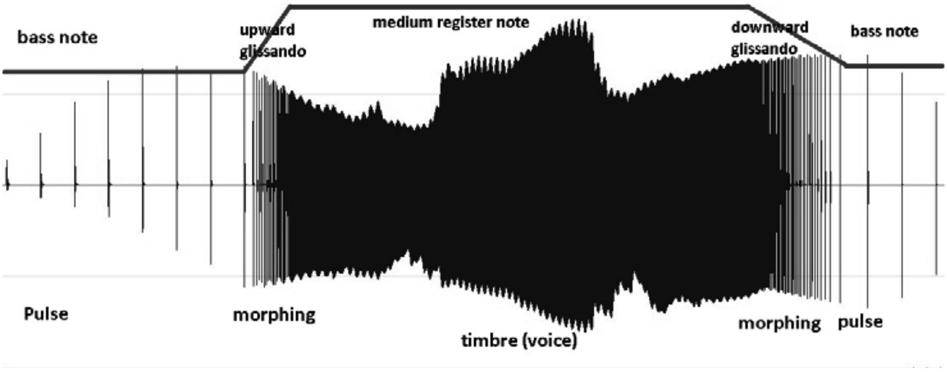
It is very common in musical literature that certain works are described as visual or spatial when they suggest or facilitate understanding through a graphical representation.

It is also common to base classifications of listening experiences on the way in which several listeners of the same work understand the music through visual, emotional, or textual explanations. Some people understand music as an emotional experience (emotional understanding), while have a more intellectual understanding of the piece and represent the work as a figure (visual or intellectual understanding). There are even those who understand music by aligning it with a story (textual understanding). It is used as a vehicle to try to explain cognitive-parametric music in another way.

Another way to understand cognitive-parametric music is in an intuitive manner, based on the concept of synesthesia. Synesthesia is used in neurophysiology for studying the phenomena of cross perception, and explains one's ability to hear colors or to see flavors. The neurological reasons for these phenomena are still being studied today, but are typically associated with certain temporary or permanent neuron dysfunctions that occur as a result of any alteration of perceptual systems. Since cognitive-parametric music is based on the idea that parameters can be inter-defined, it can be, in some ways, explained by these phenomena: in the same way that a synesthete can taste colors, we can perceive pitches through rhythm. Unlike with synesthesia, however, these inter-definitions are not real but semiotic; it is essential that there is no any central parameter for them to work.

As seen from the perspective of synesthesia, cognitive-parametric music attempts to gain insight through the parameters considered in the work. Synesthesia crosses the perception of the senses, just as parametric music crosses the properties within the same sensory perception, permitting us to perceive the dynamics through the pitches or the dynamics through the timbre.

You can see an example (https://youtu.be/2E89sda8JFs) of this parametric inter-definition thought the concept of parametric morphing. In this example, we begin hearing a pulse (an object perceived as temporal). By making an upward glissando, we get a voice-like sound (an object perceived as timbral). Thus, we have a sound object that is either perceived as a temporal or timbral object, depending on its frequency. In this way, we can gradually convert an object perceived as temporal to one perceived as timbral by slowly increasing the frequency.



Cognitive-parametric music is thus technically defined as the use of a series of formal structures and materials that are based on the concept of the parameter as sound material.

The consideration of the concept of parameter as sound material parts from the abstraction process of traditional sound materials by interpreting traditional materials abstractly from a parametric perspective. Schoenberg taught us that it was possible to take a sound material like melody, define it within a parameter (the sound pitches), and reinterpret it in terms of another parameter such as timbre, which creates a melody of timbres. In parametric jargon, this is referred to as a parametric translation. By generalizing this procedure, we can also create materials such as scales of parameters, melodies of parameters, parametric modulations, etc. Parametric materials derived from an abstraction of traditional materials become disassociated from their dependence on a certain parameter.

Cognitive-parametric music arose from a search for music without any parametric centrality. It questions the need for an element that acts as an organizing center for a sound stream to exist. The objective is to create sound flows that are grounded from nothing *a priori*.

The listener is intended to interpret my music in different ways. My works are like a kind of multi-channel broadcast in which each participant can choose one of the channels, interpreting the sound flow differently from others depending on the chosen channel. The music is relative to the person who listens. The magic of the sound fact takes place in the perceptual system of the listener; what is heard is part of the artistic event.

Disassociating the sound stream from its dependence on a process with a central parameter can create multiple concurrent parallel processes, each one associated with a different parameter. The listener will choose which one of these processes to focus on, thereby determining his personal experience of the work.

Cognitive-parametric music was first born out of a search for a meaningless of the sound events. Removing the frame of reference from which a sound event is understood was a fundamental first step. Cognitive-parametric music began by searching for non-alienated music; I wanted to find music in which the meaning was open and revealed at the moment of listening, and wasn’t given *a priori* by the composer. I soon realized that a thorough reflection on the significance of sound objects was necessary, which led me to the field of sound semiotics. I then developed strategies to break the usual meanings of sound objects, which can be heard in my earlier works like *End Game.*

The concept of settling fact, which was based on cognitive models, allowed, among other things, the sound discourse to not be defined by the stress, as in the relaxing process of certain material properties based on a parameter (e.g., the dissonances or the removal and subsequent approach to a particular starting point). This concept associated with cognitive models allowed me to understand, from the very beginning, that the process of tensioning depended upon the cognitive tension, not from the material tension. This emancipation of the tensioning processes, by replacing the material dissonance with the cognitive dissonance, is what allows a material to have multiple loads of multivalent meaning and will at last allow for its free decoding.

The reflection on the meaningless aspects of sound was based on the idea that any element can lose its individual meaning by being stripped from its usual reference framework. Some sound mass compositions, such as those from Scelsi and Xenakis, have been investigated with this in mind. In these cases, a sound could lose its significance and individuality by being integrated into a sound mass. In my compositions, however, I intend to discover the lack of meaning not by a loss of significance arising out of the loss of individuality, but through means of un-referencing, which does not require a sound's integratation into a sound mass.

Thus, the concept of parametric neutralizations occurs when an individual item loses its meaning through the neutralization of its meaning.

Parametric neutralization, a material closely related to the signification space, was the first one I worked with. The signification space is a logical function that maps the significance of a particular event in terms of another. For example, we can condition the significance of a parameter in terms of another parameter, a process that I implemented and investigated in the works between *End Game* and *The Studies*. I tested parametric neutralizations and parametric modulations in these works but only associated each of them to a single parameter, and never to all of them at once.

What naturally arose as a result of this process was the need to create a work based on a signification space in which parametric neutralizations were made in all parameters at the same time by interrelating parameters with each other rotationally using a cognitive model. This produced an already consciously cognitive-parametric music, which is clearly represented in *Parametric Neutralizations Studies*.

Parametric Neutralizations Studies arose before my need to generalize the procedures for applying parametric neutralizations to all parameters at the same time in a systematic manner. To do this, I used a rotatory parametric modulation structure in which a single parameter in each fragment determines another third through the signification space, while the rest of them remained neutralized. The goal was that the significance of a parameter was to be conditioned by another, depending on the cognitive model. The intelligibility of the process occurring in one parameter is associated to the process that occurs in another.I soon realized that it was necessary to base the process on some sort of cognitive strategy that helps listeners to recognize these determination flows from one parameter over the others. I then determined that the settling fact should be based on some sort of cognitive theory that would make the literal recognition of these structures possible. Thus, we can define, in a more precise way, a cognitive-parametric work as a series of rotating parametric modulations in which a parameter in each fragment is central and then neutralized in the following fragment, occurring through a parametric modulation based on a cognitive model.

Finally, I was able to produce music in which there was no center. However, the attentive reader may have noticed that I have defined parametric music as a series of fragments in which any parameter is central. But didn´t I say before that I didn’t want any central parameter? Effectively, the idea of this work is that there is a lack of centrality at the macro level, although in each time a parameter is central; in other words, if we see the work from a distance as an entity, any parameter can be seen to dominate the discourse. It is the same as seeing a tree or the forest, where if we see a tree, we don’t see the forest. If we focus on a particular fragment, a concrete parameter will be the determinant, but if we look at the overall structure, there is no key parameter nor any parametric hierarchy. Of course, the matter is somewhat more complex than what can be explained here (see the analysis of this work for more detailed explanations), but, indeed, making a cognitive-parametric work where any parameter is central from beginning to end became a goal that I would later achieve.

The next step consisted of systematizing the concept of parametric modulations and studying it carefully. The parametric modulations used in *Parametric Neutralizations Studies* were very crude, and at the end of the work I considered thoroughly demonstrating the multiple possible ways to perform parametric modulations that had barely been used in the first study.

To do this, I made the parametric material and the scale of parameters easier to understand. This led to *Parametric Modulations Studies*, which is a constant modulation between scales of parameters. Just like a tonal work whose structure can be defined, among other manners, by the way in which modulations between tonalities are made, we can define a parametric structure by the way parametric modulations are produced between different scales of parameters.

The scale of parameters is the parametric material *par excellence,* allowing us to define what a parametric work is structurally and acting as a constant modulation between parametric tonalities.

I will try to explain it slowly but briefly. In this context, parameterizing a work consists of enumerating the parameters that are to be considered in the work, which can be as many as you like since this is what gives meaning, and therefore significance, to understanding the concept of parameter as compositional material. In the same way, we can choose one melody or another based on its suitability to a given musical structure. We can choose a type of parameterization or another based on the parametric idea of the work. In his book *Formalized Music*, Xenakis proposes an enumeration of sound properties of the sound events (timbre, duration, pitch, and dynamics, which he calls variables rather than parameters), which we can consider as the classical interpretation. That is why I used it in my first two studies.

In tonal music, for example, a melody is chosen for its possibilities of integration as material in the form. And in serial or twelve-tone music, series are chosen by the adequacy of its properties to the serial concept of the work. In cognitive-parametric music, the choice of the number of parameters taken into account as a parametric row (or series) depends on the parametric formal concept of the work. For each parametric formal concept of a work, there is a scale (or row) of parameters which, through its properties, is the most interesting for accomplishing its concept. This is what ultimately defines how a parameter becomes a sound material for the parametric form. Each work of cognitive-parametric music has a parametric series that is custom designed with a particular parameterization of the sound objects, used alongside a cognitive model that will determine which parametric material is the most appropriate. Returning to the specific parametric series we are speaking about, we can, on the basis of a parametric series, create scales of parameters that are subsets of all parameters considered in the work.

We can create several scales that are derived from this parametric series. For example, if we consider all possible scales of 3 parameters, the equivalent to each of them is a tonal parametric scale: timbre, pitch, and dynamics, timbre, pitch and duration, etc.

So, we can now define a cognitive-parametric work more precisely as a piece of music composed of the following items: a particular parameterization (which entails a parametric series that can be decomposed into several scales of parameters) as a structure that defines the way in which parametric modulation is performed. And a cognitive model which gives meaning to the conditioning of determination flows and establishes the load meanings in the parametric formal context.

Somehow, I reached the first parametric music paradigm in *Parametric Modulations Studies*, but there were still several things to improve, one of which we've seen. On the one hand, it was necessary to avoid that at each time a parameter was central, but on the other hand, it was necessary to formalize the meaning of cognitive-parametric music more accurately and formally to differentiate the parametric music from the standard kind. Moreover, I also should examine the concept of time and movement more closely, issues that were implicitly but not explicitly present in the two earlier works.

I soon realized that the relationship between the size of the present window memory and the size of the sound objects determined the experience of psychological tempo and indicated the problem of movement in music, so I decided to integrate time and movement concepts within my music. The integration of the two, as something unbreakable, led me to reflect upon the relativity of time in music in a natural way, since the relativity of perception of psychological tempo was related to the way in which memory was capable of retaining certain materials, depending on the size of the psychological window present. I found several perceptual theories about the relationship between the psychological present and memory (e.g., Dowland), which corroborated my hypothesis and were used as cognitive models.

I therefore decided to formalize a theory of the relativity of time as sound material, derived from its intimate integration of the concept with the movement of the material. I began by formalizing what could be a relativistic system and what could not, but I knew that I needed something that would allow me to avoid making tempo the central parameter in the work.

Finally, I found the key in the phase concept. The phase is something that is not directly perceptible, but is related to time. I generated a work with two audio streams (or two voices in the Boulez sense), each with a characteristic pattern moving with respect to each other at a different speed (movement problem). The relative phase will determine the rest of the sound parameters considered in the work.

I had found the solution. First of all, I had a very rigorous formal system that allowed me to algorithmically formalize all the details of the work. The relative movement of one audio stream to another would determine the psychological perception of tempo, depending on the ability of one's memory to recognize patterns. If the memory recognized patterns, then there would be a perception of temporality that is also associated with the size of the psychological window present. If such recognition did not occur, then the perception of temporality would be very diluted and detached from the events of the movement of the material. The fact that one or another thing happened is relative to the different memory capacities of each listener.

We can now define accurately a second parametric music paradigm as a cognitive-parametric system that formalizes how some parameters are determined by their position to others with a particular pattern of movement, as well as a series of cognitive models that define how such determination will allow the relative listening. Cognitive dissonance will thus be relative to the listener rather than the objective material qualities.

In summary, cognitive-parametric music seeks to disassociate tension from the objective qualities of the material defined around a central parameter, allowing a cognitive tension that does not depend on the material objective qualities but instead on cognitive processes that take place in the person who listens to the work.

January 2013

2.The trilogy

Introduction to the studies

The studies outlined here are three works that emerged from the need to establish several composing techniques in a more systematic and structural way. These new composing techniques have been used and developed in previous works of mine, but it was necessary to explore their possibilities deeper in order to endow them with a certain level of formalism and make them a bit more rigorous. The studies investigate whether or not it is necessary that a certain parameter dominates musical speech.

The starting point of these studies is with my previous works, in which I tried to generate multiple simultaneous streams to enable multiple parallel listenings of the same work. Works like *End Game* or *Sounds Stains* are designed to make the musical components highly ambiguous, allowing multiple readings. The main objective is to get a relativie listening so that the public could create their own system of decoding the meaning of sound objects.

In these early works, I presented some unreferenced material separate from its normal interpretation frame, forcing a reinterpretation. Following Nono's idea of "Infiniti Possibili" I relied on the idea that enough ambiguous material can have multiple interpretations. This idea that Nono could perceive as well as see in architectural spaces like the crypt of the "Colonia Güell" led him to profoundly reconsider the relationship between physical space and sound. This same concept has been taken up in my work.

From work to work, I gradually became aware of the fact that in order to generate multiple listenings and separate unreferenced materials from their usual meanings, it was necessary to seek a lack of meaning in sound events or, even better, multiple significant sound events relative to its context. Rather than seeking the dissolution of the perception of a parameter as an individual thing by integrating it into a cluster as Scelsi or

Ligeti did, I preferred to neutralize the meaning of the sound elements by the context. This led me to my work in *Sisyphus' Regret* or *Sounds for Occupying Impossible Spaces*.

The purpose was to avoid the significance of sound objects. It was a reflection on sound semiotics and objects that could bring amount a lack of meaning within sound events that brought me to the concept of *signification space,* which is an extension of Nono's reflection, and signifies the power to achieve multiple listenings through the neutralization of meaning. In works such as *The Return of the Rebel Man*, *Sound Stains,* and *Squashed Fly on the Tablecloth*, all of these ideas were already present, as tested in my previous works, as well as the parametric neutralization.

The logical consequence of the development of these works was to carry out a work in which the parametric neutralizations were made simultaneously in all parameters; this was achieved in *Parametric Neutralizations Studies*. I then needed a model that would integrate and make possible these multiple neutralizations. It wasn't enough to have simultaneous neutralizations; I also wanted to establish a global structure that guaranteed that any parameter could be dominant. This structure couldn't be based solely on the dissolution of individual parametric elements; it has to also attempt to dissolve its meaning. The integrated solution that enables neutralizations, like the lack of meaning, was a gestural rotary cognitive model that conditioned the determination flows of a parameter over the others in turn, making sure that every parameter was given the opportunity to lead the process. *Parametric Neutralizations Studies* was created out of the attempt to produce a work without any central parameters.

A reflection on the exhaustion of material dissonances – which led to the crisis of modern music and the analytical thinking in dialectic materialism, and was not able to explain the new social phenomena of thought control – encouraged me to contemplate the relationship between them. This contemplation is how I found a shortcut through cognitive dissonance, which led me to redefine the limits of dialectical analysis technologies rather than those of material dissonances.[1] In this sense, reading Sartre's *Critique of Dialectical Reason* was an incredible source of inspiration because it allowed me to meta-reflect on the dialectic itself, as seen in my texts, "Intentionality of Methods," "Rhizomatic Systems Against the Dialectical ones," and "The Myth of Confrontation and Political Ontology." Influenced by my reading of Adorno's reflection on new music aging, I began to think about a new kind of music criticism regarding dialectics alongside the growing tendency of abstraction and the relationship between meaningless and material changes, since the tendency towards abstraction implies the removal of any reference point that could be used as a privileged center. It is important, therefore, to base the concept of the new criticism not so much on finding a more dissonant material (in a dialectical sense) or an explicit content both disempowered and reabsorbed, but on the absence of centrality and the unreferenced meaning and its logical consequence: the cognitive dissonance.

Introduction to cognitive-parametric music

Cognitive-parametric music is a possible solution to the creation of music without a central parameter, introducing new compositional technologies based on new musical material that comes from the concept of parameter.

The history of music can be understood as a process in which there has been always a control over an increasing number of parameters. Since the Baroque period to now, the control over parameters such dynamics, timbre, or space has increased; indeed, the number of parameters that a composer uses as material has risen. This increase in the number of parameters has allowed new musical concepts. The melody of timbres and certain concepts like integral serialism or spectral music would have not been possible without the creation of various composing technologies. These new ways of composing have favored the examination and control of a larger number of parameters.

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[1] On a conceptual level, the difference is quite clear, but inside the work itself, it is not so clear, because the cognitive model that defines cognitive dissonance is sometimes grounded on the material dissonance.

> The fact that then, as demonstrated palpably the Musical Offering and Art of Fugue, instrumentation and instrumental timbres were not as defined as they are today reveals a fundamental difference: the timbre did not operate as integral composition ingredient in the sense that, since the nineteenth century, has led to the melody of timbres and timbral organization scales in series. (Adorno, dissonances, p. 141)

In these three works, I have developed a group of formalisms, techniques, and concepts that allow the parameter concept to be used like musical material. *Parametric Neutralizations Studies* uses parametric melodies (i.e., sequences of sound objects) in which only one parameter is central.

The concepts of **scale of parameters** and the modulation among scales of parameters are improved in *Parametric Modulations Studies,* in which I developed a few **parametric modulations** techniques. One of these is **parametric serialism**, a new formula where a parameter row is used as musical material.

Finally, in *Parametric Formalizations Studies,* a formal method is created to define, in a very precise way, what exactly is cognitive-parametric music.

In non-parametric music, the formal structure is defined by the contrasting relationship of certain parameters during the composition in virtue of a central parameter. For example, in tonal music, the form is defined by the contrasts in sequences, each of which has a certain group of pitches that dominate to indicate the central parameter. These parametric works were created to define a sort of formal structure established by how the parameters are determined, thus transforming the parameter itself into a music material.

The context

These pieces are very special to me. They are the result of a long and extensive research process over time. From each of them, the following one was produced as a twist of the screw made by the critics of the previous one. Although I consider them to be the best in my oeuvre, those that have been premiered have not been extremely successful. In fact, they received far worse reviews than *End Game* or *For Rachel Corrie*, both of which were more successful. There exists in these works a strange paradox; although they are my most original works, they do not sound so original when the public listens to them. These three studies have been the most difficult ones to compose because of their complex structuring level, which made it very difficult for me to find new ideas that were also musically interesting. Despite these challenges, I believe some of my most inspired moments are in these works. When I completed each of them, I felt that the newest one was much freer and less deterministic than the one it succeeded, and the innovations I employed would be put into practice once more. They represent an experimental process that has been ever-growing. I can also say, through experience, that the public, the critic, or even the composer himself can appreciate the works in the same way. In my case, there is a total divergence between all 3 sets of listeners.

After *Parametric Neutralizations Studies*, I wrote *Isostasia,* which is a much freer work. I also wrote *For Rachel Corrie* while still working on *Parametric Modulations studies* and prior to *Parametric Formalizations Studies*. In these intermediate works, I expressed the experimental needs that held me back in the others.

These studies were about picking up a series of procedures used previously and defining and establishing them in a more precise and systematic form, hence their name. The ultimate aim was to demonstrate the full potential of these new techniques, as the studies clearly embody them.

These pieces are a political critique of the manipulation of knowledge in our political situation; by thinking in terms of just one central parameter, for example, the budget of any particular class's interest is put as central (see my articles on political parametric translations). The common belief and lazy habit of seeing our social reality from one point of view wipes out the rest of the social objects (see my political text “The Myth of Confrontation and Political Ontology”) and generates tautological processes that make these theories function as a self-fulfilling prophecy in itself, which carries with it its own compliance. It thus leads us to unalienation to denounce that a certain idea is determined by a false centralization and placed there by an interested power. In the same way, not basing a musical speech on the centrality of any parameter makes music become unalienation too, allowing a free decoding of the sound entities and their relationship. There is no justification for putting a particular point of view or a parameter in the center. Denouncing the falsehood of all kinds of centralism (parametrical, racial, ethnical, social class, gender, or any other nature) allows for the possibility of seeing reality in a more objective, open, and sincere way. Furthermore, these studies allude to a second necessity integrated into the paradigm of abstraction and meaningless of materials through an exploration of tension through cognitive dissonances rather than the properties of materials.

These works attempt to answer questions of whether or not it is possible to compose music not based on an absolute reference point or a central parameter. The conductive thread of these works is to question whether a parameter that acts as central in the work, around which the other ones are articulated, should exist.

These works attempt to create a kind of music that helps us to deconstruct false centers settled in our lives. They are an attempt to give us a different view of what is reality and how we live in it. In a world in which all political systems seem to be based on a single centered thought, disassembling centralities could point us to a different way of seeing reality, as we overcome our limits regarding what we believe is possible.

The works

The first work of the series is *Parametric Neutralizations Studies* and was born in the classroom with De Delás, when he proposed that I compose a work for orchestra. The work was premiered at the *XXIII Encontres* in the *Auditory of the Superior Conservatory of The Balearic Islands* in January 2003, thanks to Matías Far. The premiere was given by the *Palm of Mallorca Orchestra,* directed by Daniel Tosi. I composed the piece between December 1999 and April 2001.

This work emerged from the idea of *signification space*, where the signification of a parameter is determined by another. In each fragment of the work, a certain parameter is the determinant while the others remain neutralized, that is, meaningless. The signification space is a logical function that allows the meaning of a parameter to change relative to the function of another one.

The signification space allows for inter-definitions between parameters, so any parameter can be the determinant of another at any moment in the work. In this way, it’s difficult to establish a central parameter. To neutralize a parameter means to halt the perception of that parameter, although it continues to exist. Scelsi, Ligeti, and Feldman are composers that have experimented with the neutralization of certain parameters through statism or by using an undifferentiated modification with a random or nonrecognizable pattern for the cognitive human systems.

The second work is *Parametric Modulations Studies*, which was created for a small ensemble with percussion, clarinet, and cello, and premiered on October 28, 2009, at the *IV Smash Festival* in Salamanca by the *Interpretation Workshop of Contemporary Music of the Conservatory of Salamanca,* directed by Javier Castro. The first version of the score was published in the journal *Quodlibet* as a separata in the 30th edition of the magazine in 2004. It was composed between November 2001 and January 2004. I made a new revised version of the work in 2011.

My goal with this second work was to study and improve the concept of parametric modulation, making it more rigorous and expanding the number of possible ways to perform parametric modulations. Its starting point concerns the analysis of the concept of traditional modulation, i.e., trying to define the concept of modulation (in the exclusive field of music, not the concept of modulation in telecommunications) as applied to parameter scales instead of pitch scales.

In every modulation, there are 4 elements: a parameter on which we modulate (e.g., pitches); two hierarchies defined by that parameter (e.g., two scales); and a common element or transition strategy to move between the two that may not exist (e.g., a common chord to both tonalities). The concept of modulation has not only been applied to the pitches in music; Stockhausen, in reference to the work Telemusik, defines modulation as the transition among passages with different characteristics. By starting from the concept of parameter scales in this study, I generated a process of *perpetuum mobile* of modulations among parameter scales. This work also has directionality, beginning with the establishment of a clear relationship between the determinations that disappears little by little. The work culminates with a kind of parametric serialism, in which any of the 4 parameters dominate the others.

A parametric modulation is the process in which a certain parameter stops being the determinant becoming neutralized and is replaced by another in the discourse. This work made it possible for me to abandon gesture as a cognitive model and develop cognitive strategies for determination flows, substituting gesture with parametric inter-definition, through the correlation of signification space which sets the determination flows.

I began working on the third piece in the trilogy, *Parametric Formalizations Studies*, in 2007 and completed it in October 2011. It is for a small chamber ensemble consisting of a string quartet, piano, percussion, and contrabass. This work represents a more advanced step of abstraction than the previous ones, facing the problem of the concept of time in music.

It is very common to read in musical aesthetics literature that time is the “stuff” of music and that eventually all composers, sooner or later, have to deliberate about time in their work. It was something I had to consider somewhere in the studies, and, in fact, it’s what I did in this work. Rather than perceive time as a single parameter, I focused my attention on all of the possibilities regarding its relationship with movement. For me, it makes no sense to consider the problem of time in isolation without taking into consideration how it coexists with the movement and speed.

Talking about time and motion as an integrated entity inevitably leads to relativity, which is something that has always been present in my music.

Parametric Formalizations Studies creates an open perception of musical temporality through the musical formalization of relativity, not in the Einsteinian or physical sense of the term but in the most primitive sense.

This involves integrating the concept of time and movement, in the same way that spectralism integrates the concept of pitch and timbre. Just as pitch and timbre are two phenomena that cannot be studied separately, time and motion must be considered similarly, as whole phenomena.

The point is that the perception of movement is relative to the listener, a matter which necessitated the construction of a formal system. In this system, the position of certain musical materials in respect to others determines the values of the parameters of other musical objects. The perception of temporality derives from this concept of musical object movement, which is so ambiguous that it can be perceived completely differently depending on the listener. The formal structure of the work searches for different perceptions of the movement. (For a more detailed explanation, read my analysis of the work.)

The second study, as compared to the first, allowed me to avoid the gestural character of the determination flow, which has never been truly convincing to me. In the third work, I managed to eliminate the fact that each fragment had a central parameter. In it, all parameters are equally central in every moment and their relative positions to one another is what establishes the determination flows. This is achieved through an integrative cognitive model, which makes it possible to substitute the rotational determination of some parameters to others and define the relativity through the position of some parameters relative to others. "The settling fact" and the rotational structures are substituted by a relativistic-positional formalization of some parameters with regard to the other ones.

Evolutionary lines of the studies

We can appreciate the connecting and developmental thread between these works: the process of abstraction, where new work becomes more abstract than the previous one. Every work seems to represent a higher layer of abstraction.

Musically speaking, we could say that just as integral serialism represents a higher level of abstraction than dodecaphonism in the sense that only one parameter is serialized, each of these new studies also represents a higher level of abstraction. As a consequence, I ended up discussing the "the settling fact," which can be seen in *End Game* and in my early works. "The settling fact" has evolved through the process of abstraction and formalization of the positional space concept, and is no longer necessary in *Parametric Formalizations Studies*.

In my first two studies, it was necessary to generate a principle order, i.e., to establish the principle of a certain prediction of sound events. This principle was called "the settling fact" because every principle of order is to put something in an order criteria. And such an establishment implies relativity, i.e., something that involves two elements: the order criteria and the elements to be ordered. Thanks to the formalist techniques I developed in *Parametric Formalizations Studies*, I could now create parametric music without "the settling fact" because the position of some elements over others is what determines the value of other parameters.

3. Cognitive-parametric music: Why compose music?

This question cannot be answered in an absolute way, or, at least, my approach to this problem starts from the reflection that it is not possible to give an answer of absolute nature. For me, the meaning of the sound fact must be dealt with firt. The statement that music can be something absolute regardless of any frame of reference is, to me, simply false; such a claim forces you to accept axioms, postulates, and tautologies with no grounds.
The meaning of sound objects, sound art, or music is set within a reference frame to which they are related. This frame is settled by the following factors:

Historical problems. The intelligibility of a sound object depends on the codes used to decode it; therefore, the sound refers to what has been composed, which is the frame of reference for its intelligibility.

Social problems. The intelligibility of a sound object depends on the position of the composer in regard to his social environment, the social function assigned to the sound objects, and the position from which the listener of the sound object decodes it.

Technical problems. The possibility of realizing a sound entity is determined by the group of techniques and knowledge developed and learned at the moment in which the composer carries out the work.

From the technical point of view, one of the possible ways of solving the problem of relativity and the lack of an absolute reference point is to compose music that lacks an absolute center. Completely decentralized music without a center determines the rest of the sound facts since none of the parameters associated with the sound fact can act as the center of the sound speech. The purpose is to generate more relative sound speeches, which can only be achieved by avoiding any centrality to which everything else is relative.

An example of centrality is tonal music, a particular organization of pitches based on hierarchies of notes involving relaxation and tensions that determine the musical discourse. There is no hierarchy of notes in serial music, but there are other hierarchies in which a musical parameter is still the determinant of what happens in others. In integral serialism, there may not be parameters that determine the sound discourse, or even a central one, but determination flows are always constant throughout the work, i.e., that is a sort of parameter organization that is set up and acts as a parametrical center. In any case, there is no reflection regarding the problem of parametric centrality in serialism; if a particular lack of center is found, it’s likely an unexpected epiphenomenon rather than something deliberately sought. What is intended, however, is a principle or order, and not the full independence of the musical discourse on a centrality. Boulez speaks to this very point:

> It (...) seems to me indispensable to conceive the interaction of sound components as a structural phenomenon of base; at the same time, it should be emphasized that these are organized according to a progression of decreasing priority. (...) With a view to a dialectic of the composition, the primacy has to do with the pitch and duration, constituting the intensity and timbre secondary categories. (Boulez, *Thinking the music today*, pp. 59-60)

For Boulez, a consciously accepted centrality exists in the hierarchy of parameters. This way of proceeding was common in serialism, characterized by fixed determination flows in the structures of parametric hierarchies.

The search for such specific music in which there isn’t a fixed flow in the determination of some parameters onto others will produce a set of compositional techniques where the concept of parameter plays a very important role, converting itself into a sound material.

The process through which we move from a situation in which a certain parameter is significant in a hierarchical structure of parameters to another in which it is not is a parametric neutralization.

The main problem from the point of view of language is rendering the meaning of sound objects indeterminate. The goal is to make certain sound materials meaningless, and such parameters are already insinuated in serialism. Adorno has already proven this, as we will discuss later.

From a social and historical point of view, the starting point is the liberation of listening.[2] The fundamental issues concern the meaning of musical objects and how they are decoded, as well as why a certain event must follow another.

The dissolution of the note as a signification space is an attempt to go beyond Scelsi, who, as we shall see, managed to render sound objects meaningless at a very high level.

This process is about overcoming the limits of what we believe to be music; in other words, it’s about making new music for a new world, where the fact of presenting other semiological understandings of a musical object implies another way to decode and perceive music. The goal is to establish a correlation between neuronal plasticity – which could generate brand-new structures of perception of reality – and innovative forms of decoding, both of which generate plasticity.[3] Therefore, discovering another way of translating sound events might lead to a variety of decoding possibilities, facilitating another vision or cognition of reality.

The importance of the liberation of listening has its foundation in social relativity. The basic principle is that we change reality when we simply change the way in which we see it. We are the limits that we believe exist, just like our reconstruction of the language through which we build our limits could help us break free of the constrictions that we impose on this language.

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[2] I understand the liberation of listening as a process or an act that encompasses only one way of decoding sound events and is avoided by the composer so that the meaning of sound objects is determined by the listener and not by the composer himself.

The term liberation used here is similar to how the Frankfurt School, and especially Adorno, used it (i.e., to the extent that, in today's society, the subject has been reified as a consumer by decoding the norms of cultural events associated with that role). Art is alienated when reified as a product of cultural consumption and the subject who consumes the product.

[3] To learn more about how music affects neuronal plasticity, I recommend the fourth part of the book, *The Cognitive Neuroscience of Music,* and especially the chapter by Glen Schellenberg.

From the social and historical points of view, we can say that music is a form of knowledge. The best and most significant musical works are those that changed the concept of what was known as music at that specific moment by turning the idea of music on its head and questioning reality. Musical masterworks are those that resist the current definition of what it is considered music at that moment and whose composers force a new definition of it upon their contemporaries.

Adorno and his concept of the historical trend of meaningless materials

For Adorno,[4] the fact that all materials derive from a single principle is an objectifier element in music. This eliminates the traditional discourse of bourgeois classicism in which each point is defined by its proximity or distance to a central point through continuous variations that occur when all musical materials are treated as a unit, and the different moments of discourse are always the same distance apart. What Adorno means by the unity of materials is the organization of all musical elements (harmony, rhythm, counterpoint) with respect to the same principle.

According to Adorno, dodecaphonic composition generates a liberation of the subject through its chaining only insofar as it’s grounded in a material historical dialectic. The serial technique is done by its power of manipulating the material, so the technique ends up indicating the material. The subject is thus liberated through the rationality that involves the total organization of the materials.

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[4] Fundamentally, Adorno´s thinking is expressed here according to his writings in *The Philosophy of Modern Music*.

A better differentiation, which he defines as a variation on what is stablished, is needed in serial music more so than in tonal. Due to the necessities of the material, bigger contrasts are necessary to avoid monotony. The consequence of this is a music where the subtle shades are not understood as a constituent of difference (or, as we will see, as a significant neutralization of an objective difference). This is why very small shades can constitute bigger differences in tonal music, producing a progress paradigm parallel to the material one. The more evolved the material, the smaller the shades, which means that a bigger contrast and differentiation is required.

For Adorno, the technique is not exhausted through the historical process of the material: it only reduces the tonal material to a state of amorphous substrate. This process originates as an abstraction of technical standards since the historical subject can only be reconciled with the historical elements (the historically specific material) in the most abstract manner, which removes certain material qualities. The qualities of the material are thus historically determined according to this process.

Adorno maintains that when the material is objectified by its own historical development, it loses certain qualities, to the extent that the determination of the qualities of material can be produced by the material itself (as tonal material) or determined by external factors (as via serial organization), and that the organization of the material is determined by external factors that cause it to lose some qualities that contribute to a certain objectivity. That objectification is what matters to Adorno because it forces the composer to renounce the material's subjectivity while being pushed to follow a set of rigid rules, thus generating a contradiction that breaks the composer free from the tyranny of material. The process of increasing the differentiation of the material implies an abstraction of its qualities that is experienced negatively by the subject. To Adorno, this concept of running away is what defines all the history of music.[5]

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[5] As we will see later on, this characteristic of indifference in relation to certain materials is similar to an indifference in the signification space in a historical process. For example, in certain paradigms of process associated to materials, there is a modification in their signification space. In a serial context, for instance, certain intervals like a fifth of a third that are quite significant in a

In my opinion, inside this idea of Adorno lies one of his most visionary views (and probably less understood and recognized than others) that goes beyond the argument of how far his dialectical analysis model extended, or how suitable it is for an explanation of today's musical phenomena. Even if these claims are decontextualized from their dialectical framework, they still have an interesting character because, beyond their application to the aesthetics of ugliness, they facilitate a logical understanding of how a material's development is dependent on its level of abstraction rather than its degree of material dissonance,[6] a quality that doesn't necessarily mean opposite of dissonance.

Adorno's idea that the more evolved the material, the smaller the nuances that can occur, which therefore increases the need for contrast and differentiation, hints at the theory that the process of increasing the abstraction of a material render the nuances meaningless. Consequently, significant space is relative to the historical use of the material. In my opinion, this the most important idea from Adorno, more than any of his others that are better known.

However, Adorno's system was unable to explain phenomena such as Cage's works due to a paradox (that he didn't realize) related to the historical trends of analytic technologies of reality, but he was still able to spot the meaningless historical trends of the material. In the same way that the meaningless material requires increasing abstraction, rendering material meaningless implies the impossibility of establishing a central parameter and accepting the concept of parameter as material. Adorno couldn't see that analytic technologies of such a social reality based on a central and fixed flow of determinations could not provide a satisfactory

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tonal context lose this meaning. They remain indifferent in regard to other intervals that previously did not have signification.

[6] In my opinion, this matter resides in the magic of Nono´s music. I think that he generated a great indifference among sound objects, bringing them to an incredible abstraction level that provided all of the great tension in his music (Cognitive Dissonance, not Material Dissonance).

explanation of new phenomena.[7] Cage is a radical first attempt in regard to this foresight.

For me, the modern dialectics paradigm doesn't refer to the noisism like ugliness or the need to increase the dissonance of the material *ad eternum*, but instead seeks to explain the model of the abstraction, noncentrality, and lack of meaning of the materials (as seen through works by Nono or Feldman). The models based on the noisism are better assimilated by the cultural industry since that population was the first to have lost its critical load by not breaking up with the expired analytic technologies and consequently lacking the ability to positively reaffirm what, theoretically, they deeply wanted to refuse. The concept of traditional dissonance has given way to cognitive dissonance, where the dialectic of material is progressive noisism; that is to say, the idea that every time that a certain dissonance level has been assumed needs a higher level of dissonance, which represents the end of the possibilities associated to the own material, is exactly what Adorno defended many times (*The Aging of the New Music*).

Adorno's paradigm of progress announces a growing abstraction of the material and the implications of a bigger abstraction on the materials' lack of meaning.

Cognitive-parametric music's tendency to use a larger abstraction of the materials emancipates the listening experiences, providing the listener with a sound stream that allows multiple ways of hearing in relation to different factors.

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[7] For further clarification, see my texts, *The Confrontation Myth and Political Ontology*, *The Intentionality of the Methods,* and *The Epistemic Possibilities of the Rizomatical Systems Against the Ones Based on Determination Flows on a Centrality*.

Foundation of cognitive-parametric music

Since cognitive-parametric music searches for a total lack of meaning in regard to the musical objects, it must be founded on some external knowledge such as semiotics, which provides an analysis of why a sound object is significant. However, to speak about meaning doesn't necessarily imply require mentions of language or communication; to say that a sound object is significant doesn't inherently mean that it completes the function of a word, that it communicates something understandable from the perspective of a human language, or even that it transmits emotions or states of consciousness. *To speak about meaning implies mainly that the sound object contains significant amounts of formal information in the context of the work*. For example, in a tonal context, a chord has meaning when it helps to establish a tonality: grade 1 would be highly meaningful while grade 3 wouldn't.[8]

The semiotics we are talking about is not intended to represent an isomorphism between language and music, but the contrary, in order to establish a way of defining how sound objects are meaningful within the formal flow of a sound stream, regardless of linguistic considerations or communicative power. As we have already seen with Adorno's rule, the higher the abstraction of sound materials, the lower its expressive power, thus increasing the release of the author's intentions and the emancipation of the listening experiences. When I talk about semiology, I'm not trying to establish a communicative objectivity; I invoke the theory to explain the generation of a listener's flow whose emancipated hearing produces multiple abstract readings.

In fact, this approach for looking for the total separation between the conception of music and the intention of oral language is necessary if the listener wants to be free from any composer's messages. We can say that cognitive-parametric music is music without a message, searching for the same as other musics focused on the liberation of listening (Lachenmann) or the dissolution of the ego (Cage). I'm not attempting to communicate any specific message, but rather facilitate a diversity of messages. That's why cognitive-parametric music is understand through the power of the information and not the semantic communication. Today's *Homo marketing* is based on the reduction society's message to the society's image. This reduction by the consumption society, also reduces the artwork's supposed message to mere show, and the lack of message dirties our current image of society. Therefore, when I speak of meaning, I am referring to a singularity given to a sound object from outside that has to do strictly with its function in the sound flow, and it defined by its insertion in the formal model of parametric integration. It refers only to its function as sound material.

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[8] Schoenberg demonstrated this concept of musical significance as it refers to the comparison of harmonic meanings of inverted chords: "Although, as you have already been said, the harmonic significance is not affected by the employment of the inversion" (Schoenberg, *Treaty of Harmony,* p. 58). Therefore, the semiotics of which we will speak doesn't intend, as its primary objective, to settle down the basis of an isomorphism between language and music, but rather the opposite.

To the extent that meaning depends on perceptive, psychological, and cognitive aspects, the study of the perceptive models and pattern recognition, as well as the intents of its reconstruction by artificial intelligence, becomes fundamental.

> The contemporary music is in front of an Aporia. After it decomposed the idiomatic element for mor of pure expression, not objectified, immediate, is no longer able of expression. From this dialectics, finally, the material emerges in a very pure and menacingly nature. The more the music resembles to the structure of the language each other, so much more it ceases at the same time of being a language, of saying something, and its alienation only ends up being perfect with its humanization.[9]

Therefore, cognitive-parametric music requires the study of semiotics, perceptive models, and theories about pattern recognition. I am reminded of Schoenberg's discussion of Brahms' third symphony:

> When Brahms introduces the second theme of his Third Symphony (F major [first movement]) in the key of A major it is not because one 'can introduce' the second theme just as well in the key of the mediant. It is rather the consequence of a principal motive, of the bass melody (harmonic connection!) F–A flat (third and fourth bars)

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[9] (Adorno, *Relationship between philosophy and music*, p. 77) quoted from "Sobre música. Compilación de textos."

> whose many repetitions, derivations, and variations finally make it necessary, as a temporary high point, for the progression –A flat to expand to the progression. F–A (4 th initial key, A, the key of the second theme). Thus, the basic motive is given by the initial key and the key of the second theme. That is a psychological explanation. But a psychological explanation is in fact here a musical one. And every musical explanation must be at the same time psychological. It is obviously in this sense also a natural explanation. Natural according to human nature. (Schoenberg, *Theory of Harmony*, p. 176)

The following chapters will summarize current knowledge regarding the foundation of cognitive-parametric music and the areas in which it should be grounded.

Semiotics of the musical objects

A phenomenon,[10] fact, or sound event is significant when it, in its entirety, or a modification of some of its attributes, has an implication, and thus implies something. We can define this as semiotic entity, as in any entity or event that has a meaning. Implication here means consequence; that is to say, that a semiotic entity implies something when it supplies information for the knowledge or understanding of something that, from the point of view of an entity (it can be itself or another entity), is relevant.

There are two types of semiotic entities[11]: those that keep a relationship with what they mean (e.g., the fumes mean fire), which are referred to as

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[10] My concept of semiotics it is rather peculiar. For a more typical musical semiotics, I recommend *Music and Discourse Towards a Semiology of Music* by Jean-Jacques Nattiez. My approach is more similar to Eero Tarasti's, as detailed in his book, *Existential Semiotics*.

[11] I follow the classical vs. semiotic distinction between signs and symbols, as outlined by Morris, Schaff, and others. According to this distinction, a sign is what keeps a relationship with what is meant, while a symbol keeps an arbitrary relationship with what is meant. To investigate more deeply the different classifications that the specialists of the semiotics have carried out throughout the history, I recommend reading chapter 2 of José Hierro Pescador's *Principles of philosophy of the Language*. I do not follow exactly any classification since I think that all of them are arbitrary. There are a lot of different theories about musical semiotics. The book of Netiez can be considered the classical approach, while mine is closer to existential semiotics.

signals, or those that don't keep any relationship with what they mean, and whose code is arbitrary (e.g., a red traffic light whose meaning has been suited by a community), which are known as ***symbols***. Nevertheless, this classification is relative and allows for an intermediate space. For example, fumes can be a generated signal and is susceptible of being coded as a symbol, and a red light can maintain, in certain cases, a cause-effect relationship in a physical system. Any entity can complete both types of semiotic functions either simultaneously or successively.

To say that something maintains a relationship with what it means makes sense only within a cause-effect pattern, but since the cause-effect scheme is for something, this pattern remains relative.

All knowledge and semiotic entities are relative to the entity that perceives it and for who it has meaning. The semiotic entities, and language in general, don't exist *per se*; they are not tautological, but rather coexist in a relative way with the entity whose position in an environment determines the meaning of the semiotic entity. In other words, not everything is language, and not all entities are semiotic. The semioticity is not a property of things. To say that all entities are by definition semiotic, is to fall in a tautology that creates the appearance that this statement is certain.[12] *The semioticity is a property of the things that has been settled from outside*, and that acts on them as other to their function. It is important to avoid the tautologization[13] in order to achieve an affirmation of something adds a load of signification.

An example of this could be the difference in the color of fumes for a tribe. To them, black fumes mean the fire is dangerous and a white one doesn't mean anything. In this way, the appearance of black smoke (a fact) as something different to the appearance of a white fume (it differs among several facts) brings them new and relevant information (it implies); they acknowledge through the colors that a dangerous fire exists.

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[12] When I speak about avoiding tautologies in this mean, I mean to speak on it in a metaphoric and simple way, as in prophecies that carry inside them their own execution. This is what I refer to as self-induction: if we constantly say to somebody that he is crazy, we will make him become crazy. If we prophesize that the market will fall, we will get it to fall because people will stop investing.

[13] Here I use Wittgenstein's idea that tautologies are meaningless.

What determines that an entity is transformed into a semiotic entity is not given *a priori* by such an entity; rather, such character is given (is settled) from outside by another entity that, for some reason, finds it significant and adds it a load of signification.
Therefore, the meaning is a property of the entities given from outside by another entity. This is even valid for the load of significations in which an entity sums to itself as its own representation as an object.

Structures of contrasts and negation

We can separate signs and symbols into two groups: those that are unalterable, and those that can be modified in time. It should be noted, of course, that this classification is not given by the semiotic entity itself, but by the entity for which a meaning is given to the sign.
The **signals that can be modified in time**, sound flow being one example, have a special character.
An example of a sign that changes in time is a diode LED that changes its color and whose change has a code. An example of a sign that doesn't change in time is a book: its meaning is always the same for those who possess the code to find the original meaning.
The associated code can also be **synchronous** or **asynchronous**; synchronous codes are those whose meaning depends on the variation of time, and synchronous codes are those whose significance does not depend on time.
An example of an asynchronous sign is an LED that can have several colors meaning different things. In a studio of analogical photography, for example, the red LED inside and outside the room indicates that film is being developed, so no one should leave or enter because of the dangers of exposure, the white LED indicates that the studio is occupied but accessible, and the green LED indicates that it is free and available. Here, the significance of the sign doesn't depend on time.
But let's imagine a sign whose meaning depends on time. For example, let us imagine an electric signal that can only have two voltages: 0 and 1

respectively. Arbitrarily, we choose the second as a unit of time. We can thus measure the value of the signal for each second and assign a random value to the signal; for example, if the signal remains the same between two points, we can assign it a value, and if the signal varies, we can assign it another one.

We can also code[14] the sign in several ways; for example, a voltage can be 1 or 0, but we can also code them in an inverse or differential way, whichever is the most important to our effects, so that a change of the sign is 0 and a permanence of the sign is 1. In this way, a transition of a voltage to another could mean one thing or another, solely depending on time and on what has happened previously.

Examples of all above mentioned can be found in music, but it is the last one that is the most interesting for our purposes.

If we have a complex signal that can be modified at the same time in several attributes (parameters) in a synchronous way, the modification of one of them can mean the change in the way another attribute is coded. Thus, the possibility of establishing a parameter that becomes meaningless is conditioned by the way in which it is coded by another parameter. This is the foundation of the parametric modulations and neutralizations.

Here is an example: let’s imagine a signal that can change its voltage between 0 and 1, and the phase of the signal can change from 90 to 270 grades. If the phase is 90, it means that the code of the voltage is coded directly, but if the phase is 270, then the code becomes differential; that is to say, that a parameter determines the change of the code or significance of the other one. But it is also possible that the phase might change without ever having significance, which leads us to the concept of parametric neutralization. Moreover, a system can include a parameter in which its neutralization is determined by the function of another one and during certain moments, or when its significance varies or is interrupted. This phenomenon by which a parameter of a signal stops holding meaning is called **parametric neutralization**.

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[14] For more on coding, see Forouzan’s Transmission of Data and Nets of Communications.

Imperceptible changes

We will now investigate how the difference between two magnitudes of the same parameter becomes meaningless.

The neutralization of a parameter implies that the difference of its value doesn't have significance. A neutralization of a parameter takes place when, during a moment of the signal flow, the modification of the parameter stops having significance due to a certain process. If the difference between two values of a parameter doesn’t have a different significance in different moments, parametric neutralization could not exist. *It is necessary that a real difference between two values of a parameter acquires its meaning through another parameter.* In the context of parametric neutralization, the important thing is the signification space, which is determined by the settling fact[15] or through a formalism. The signification space allows the position of each event of a sound flow, in regard to another axis of references of that flow, to determines the significance (see *Parametric Formalizations Studies*). Therefore, there is an aspect of signification space that determines when an event is significant.

To neutralize a parameter means that the value of its signification space passes from any value to 0. We can achieve this by modulating the value with another parameter. (Here, I don’t mean modulate in the musical nor the telecommunications sense.) In turn, this second parameter should be modulated by another of a different nature (it is of gestural origin in *Parametric Neutralizations Studies*). *Finally. it’ll be the listener who determines which parameter is the most important in the listening.*

This is exemplified through the recognition of allophones. In certain languages, some allophones aren’t relevant for the recognition of certain words, and a word that is pronounced employing different allophones remains the same. In other languages, however, the same allophones can determine a particular meaning of a word. Therefore, something that is the same thing from an objective point of view (i.e., that there is an operationally defined metric) in two different languages can mean something different. In this way, the signification space assigns different allophones to a meaning depending on the language.

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[15] This can be avoided through a process and parametric formalization, as utilized in *Parametric Formalization Studies.*

In music, the move from tonal music to serialism represents an abstraction and indifferentiation (Adorno) that implies a decrease in the signification space. Certain combinations of notes that have a high significance in tonal music lose their significance in a serial context. Therefore, we can say that the signification space assigns significance to a musical or sound event (i.e., an interval or a succession of notes) in relation to the compositional technique. This is what Adorno enunciated in regard to the historical tendency of the material. Thus, the consequence of the tendencies of the material is the growing abstraction and loss of meaning, as associated with its use in an appropriate context. Moreover, cognitive-parametric music is characterized by the fact that the significance of an event varies throughout the same work. In this way, *each parametric composition has a signification space that is assigned to a certain musical object or a difference of its values in a parameter, a meaning in function of the time, or the formal outline of the work.*

The modulations from one parameter to another are carried out in several forms, one of which is through the concept of parametric inter-definition by the signification space.

Foundation in the musical psychoacoustics

Psychophysical predisposition in childhood

It seems that children already have certain capacities to recognize sound patterns before their acquisition of language. This is explained by children’s ability to recognize their mother's voice. The children focus and pay special attention to their mother’s voice, which sounds a fourth higher than the normal one, meaning they pay more attention to the highest notes.[16] Some of these musical aptitudes conform in some way to tactics of survival.

Likewise, the recognition of pitches is simpler when the octave is divided into irregular parts than when it is divided into regular parts.[17] Children are able to recognize transposed melodies, and it also seems that they have a certain predisposition to listen to the contour of pitches, which can be related with the contour of the mother’s voice; in fact, the recognition of pitch contours is the most fundamental characteristic of prelinguistic babies. In addition, when children are listening to music, they pay more attention when the dominant pattern changes, thus indicating that a predisposition to pay attention to change exists.

Babies are able to recognize transposed patterns of pitches and rhythms in which the tempo has been changed. Children of 9 months of age identify and differentiate sequences of the same pitches but with different rhythms. If the rhythms are binary, the recognition is simpler. The perfect fifth seems to facilitate more success in the recognition of melodies. In some way, the song and the mother's voice can influence these phenomena; when women sing, their voices are higher than usual, but when they talk to a baby, their voices increase by three or four semitones, in comparison to the increase of only a single semitone when they are singing to the baby. Newborn pay greater attention to recordings that better imitate their mother’s voice. Among versions of the same song, babies generally listen longer to those sung in a higher register. It has also been proven that babies up to 6 months of age pay more attention and are quieter when they hear their mother singing, in an almost hypnotic manner, than when they hear her speaking. It is thus not strange to note that mother's voices have been related to certain regulatory functions in regard to the psychological welfare of babies.

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[16] This information is taken out of chapter 1 of *The Cognitive Neuroscience of Music*, edited by Peretz and Zatorre, titled *Musical Predispositions in Infancy* by Sandra and Trecha.

[17] One can see this concept in the analysis of *Parametric Neutralizations Studies*, particularly how it is used to establish the flows of determination. The structures in this work combine symmetries and asymmetries, which allow more attention to be focused on the asymmetric processes.

Tomatis[18] has studied the way in which sounds already begin to have meaning to a fetus. Tomatis defends the thesis that the fetus cannot only hear sounds, but also select them. According to Tomatis, the baby is submerged in a medium prevalent sounds (e.g., stomach’s noises, mother's heart, mother's breathing, etc.). These sounds, called base, arrive at a frequency of 1000 Hz and are transmitted through the amniotic liquid (a kind of mass) and although they lack significance, they are perceptible and constant for the baby. However, the fetus ends up ignoring them, meaning that they are neutralized without being perceived. According to Tomatis, the abdominal wall is a potent acoustic isolation that makes anything impossible to be heard from the exterior unless they overcome 100 dB. Therefore, the fetus cannot hear music or the father’s voice, unless they arrive through the mother's skeletal system. According to Tomatis, the mother's sound is also recognized only if it arrives by bone conduction because bones’ rigid structures transmit high frequencies better, and these sounds are the only ones that babies pay attention to.

Tomatis also discusses how the way in which a mother talks to the fetus can be radically influential. The conditions of the pregnancy determine if and how a mother talks to the fetus, and these are already psychologically marked.

According to Tomatis, the mother's filtered voice can provoke intra-uterine regressions. A baby is able to recognize his mother's filtered voice and distinguish it among several voices of various species such as pigs. For example, when listening to several speaking recordings of his mother's voice talking to her all of her children, he is even able to recognize which phrase is directed to him. This was found through an experiment that requested a mother to talk as if she were speaking to the fetus of each one of her children, making differentiations in her voice for each. The speech was recorded, treated with filters that simulated the mother's interior, and finally played back to her children. The children could successfully recognize which one of the speeches was directed to them. According to Tomatis and André-Thomasand as demonstrated in this experiment, newborns can easily recognize their mother's voice.

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[18] Alfred Tomatis*, 9 Months in the Paradise: Histories of the Prenatal Life*, 1st ed (The Timbre: Barcelona, 1990).

For Tomatis, hearing begins to be developed on day 15 and is already functional by the fourth month.

At the moment that he is born, the baby passes from a liquid audition to an air audition, a transition that can be traumatic; in spite of the difference between these kinds of hearing, however, the memory makes possible a very successful recognition task. The step from liquid to air is gradual and lasts about 10 days, which allows time for the amniotic liquid that has been retained in the middle ear to be reabsorbed. During the phase of intrauterine liquid audition, the inner ear is the only one that works. The ability to recognize patterns primarily matures as the fetus develops its hearing so that it can recognize the patterns that underlie the differences of the sound of the mother's voice in liquid versus air.

Chistophe Petitjean carried out an experiment to measure the fetus' reaction to different frequencies; most measurements of the baby's heart frequencies were located between 100 Hz and 3000 Hz, and increased up to 8000 Hz.

Cognitive rules and models

Cognitive-parametric music can be explained by demonstrating how masters have established cognitive rules. As we will see, such rules are not new; indeed, they were exploited in various musics of the past. But the newest application of cognitive rules is its ability to generate cognitive tensions in cognitive-parametric music, a process that opposes its own logic.

I will begin with Schoenberg, the master of masters and creator of modern music whose work is a precursor (if not the innovation itself) of parametric neutralizations. Let’s see how Schoenberg enunciates a cognitive rule:

> Thus, repetition will generally be avoided, except our aim is to give to any chord an extraordinary significance. At present we can have this aim with one chord only, with the last degree, the one that gives the key. By repetition we will lend this chord prominence in our little phrases and thereby express the key, event fat present not very convincingly. The most practical arrangement for this repetition is simply to put this chord first and last; because the first and last impressions leave the deepest imprint. Besides, some variety is achieved if the repetition of the chord is postponed as long as possible, so that in the meantime something different, some contrast occurs. Therefore, the first condition we impose reads as follows: The phrase begins and ends with the triad on the last degree. *Consequently, because the common tone is required, the next to last chord must be able to connect, according to our table, with the last degree: thus, it will have to be III, IV, V, or VI*. (Schoenberg, *Theory of Harmony*, p. 42)

Here we can see how a cognitive rule (underlined phrase) is used to justify two musical rules (italicized phrase).[19]

All of traditional music is based on cognitive rules. Relevant composers don't need someone to tell them what the cognitive rules are for; by studying such composers, we can better understand how cognitive rules work.

Here, Schoenberg provides a statement on one of the basic rules of pattern recognition, emphasizing that the first and last elements are the

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[19] A similar cognitive model is used in *End Game* to establish the settling fact. See my analysis for further explanations.

most important. This is one of the rules that grounds the concept of the settling fact since the brain reconstructs the sound flow information based on what it defines as the first and last elements. The recognition of patterns associated with the sound phenomena is thus carried out using these cognitive rules.
Another precursor of cognitive-parametric music is the work of Grisey:

> Notre perception est relative, elle compare sans cesse l´objet qu´elle vient d´appréhender à un autre perçu auparavant ou encore virtuel, localisé dans notre mémoire. **La différence ou l´absence de différence qualifie toute perception.** Nous ordonnons ainsi le perçu non en fonction d´une norme unique mais en l´insérant dans un réseau de relations pour en dégager la qualité intrinsèque. (Grisey, *Écrits*, p. 29)

In these lines, Grisey enunciates one of the most important cognitive rules: the relativity of perception depends on the difference or absence of difference to provide the basis of parametric neutralizations.

For Grisey, the perception of movement has to do with the change. If the music does not change and is very predictable, the time expands, the perception is more exquisite, and there is greater focus on the details. But if the music is very unforeseeable, the perception contracts and diminishes. For Grisey, **the sharpness of the auditory perception is proportional to the temporary perception**.

> Il s´agit là d´une loi de la perception qui pourrait se formuler ainsi: l ´acuité de la perception auditive est inversement proportionnelle á celle de la perception temporelle. (Grisey, *Tempus ex machina*, Écrits p. 77)

Miranda establishes a more generic cognitive rule that reveals how the perception of the different parameters is not additive, meaning that the attention that we lend to a certain parameter is subtracted from another. This is what happens to the senses as well: paying too much attention to one sense (sight, for instance) above others usually causes us to miss details.

> Regardless of musical style, an increase of focus on certain parameters in a musical passage should be accompanied by to decrease of focus on others. The human mind has an attention threshold beyond which music is most likely to be perceived pace lacking order or direction. For instance, if the intention is to focus on melodic lines,

> then one should refrain from making too many contrasting stamps variations while the melodies you plow unfolding. Otherwise, the stamps may distract attention away from the pitch. (Miranda, *Composing Music with Computers*, p. 13)

The fact that the perception of the musical parameters is not something isolated but instead related to the others is a foundation of parametric music. This allows us to focus attention on a parameter and to neutralize our attention to other, or, even better, in the case of a saturation of several parallel processes, we can use our listening to focus what we find more interesting.

Therefore, the integrational cognitive models define the form in which the perception of some parameters influence others.

The inter-definition of parameters is thus based, among other strategies, on models derived from these explanations.

These cognitive rules ground cognitive-parametric music. Cognitive-parametric music doesn't take the idea of pitch and timbre integration from spectralism, but rather seeks to be the first musical school to use cognitive models to explicitly establish formal relationships. To do so in an implicit way has already been done.

Habituation and expectative phenomena

When a listener faces an audio signal, there are several determinants that make that signal interesting to him and allows him to be attentive. The recognition of patterns is one such determinant. The listener will pay attention if he recognizes certain types of regularities in the signal flow. If there is no pattern in the flow, or they are difficult to recognize, the listener loses interest. On the other hand, if the flow is a repetitive pattern, the pattern stops being interesting once it's identified. In the case of a flow with a recognized pattern, listening remains attentive and a slight change will create a new recognized pattern. Attention will then come back in the same way if in a new Pattern A ppears is recognized.

The idea of cognitive dissonance is based on these phenomena. The sound flow is coded by a series of regularities which simultaneously introduce a certain variety inside the same flow; therefore, a series of regularities are needed during the introduction of the variety. Cognitive dissonance takes place when events that cannot be interpreted as a regularity can neither be interpreted as a variation of the regularity. This is why there aren't heavy cognitive dissonances Reich's music, since the pattern of difference in the regularities is very stable. However, in Nono, we find the opposite: the great variation in speed of the materials' introductions make his work have an impressive cognitive dissonance.

For these reasons, cognitive-parametric music will always establish a flow of several patterns in such a way that the pattern elements can be interpreted as belonging to another pattern; this is the idea of multivalency that has already explained (see *End Game*). The ability of a listener to recognize the regularities around patterns is fundamental to cognitive-parametric music.

Neutralization of the parameters

We are going to analyze several musical examples in the current literature that pertain to the concept of neutralization.

The first approach was summarized a few paragraphs earlier when we were talking about musical bias during childhood. In the fetus, a flow of constant noise ends up being ignored, although the noise is there the attention given doesn't take place; losing the ability to even be conscious of this noise. A form of neutralization is to maintain the idea that something is motionless so that one's perception loses focus.

Pierre Michel,[20] in reference to Ligeti's work, states that "The melodic, harmonic and rhythmic individualities are neutralized" (Michel, *György Ligeti*, p. 40) and later that, "in atmospherès Ligeti neutralizes the pitches and the rhythms totally, the two important parameters are timbre and the intensity" (Michel, *György Ligeti*,p. 46).

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[20] Pierre Michel, *György Ligeti.*

We can thus say here, intuitively, that to neutralize means that a certain parameter lacks musical importance. For example, *atmospherès* demonstrates a rhythmic neutralization through a motionless sound, where the neutralization of the pitches perceived through the use of clusters, rendering the pitches of individual notes insignificant. In Ligeti's piece, the pitches lose their meaning by being integrated into a sound mass in which they are not individually recognizable. *The progress of cognitive-parametric music, in relation to the neutralizations that existed before, is that the neutralizations are not derived from a loss of the objects' individuality but from a loss of the objects' significance*. This process of dissolving the individuality of the objects is not achieved by neutralizing them but by dissolving their meaning. The purpose is not to neutralize the objects by making them lose their individuality, but by making them lose their meaning. For that reason, the semiotics of sound is important for carrying out the studies.

To be more precise, in a work or style of music, a parameter is neutralized when it lacks importance within the conception of the work (this is just one possible meaning of parametric neutralizations). By following this definition, we can say that there is a certain neutralization of the timbre in Bach's[21] *Well-Tempered Clavier* since it can be executed with different timbres without change the musical meaning. Music that can be played with any instrument has neutralized the timbre, music that can be executed on any note neutralizes the pitch, music that can be executed with any rhythm neutralizes the rhythmic patterns, etc.

Grisey refers to the neutralization of pitches in his 1998 article of *Vous avez dit espectrel?*:

> In sum the serial music neutralizes the parameter of the pitches, but this involuntary neutralization allows the concentration and the emergency of necessary new techniques to avoid the monotony. (Grisey, *Écrits,* p. 121)[22]

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[21] This statement should be understood as only one basic example to explain a concept. What is said here is only certain until a certain point, and much more complex and truthful studies could be carried out on this subject.

[22] This statement can also be considered as an interpretation of Adorno´s theory regarding the relationship between the abstraction of material and its indifferentiation.

In this sense, to neutralize means to avoid hierarchies. Serial music neutralizes pitches (in a relative way, I might add) because it differs from tonal music, in which the hierarchization of pitches is the foundation of the musical speech; in the former, hierarchization is no longer structurally functional and a dominant parameter no longer exists.

Grisey specifies another kind of parametric neutralization in which to neutralize means that a parameter is not important to the sound development, even though all elements of the work are notated. In this way, as aptly demonstrated in Ligeti's work, *apparitions*, the pitches and rhythmic events have a structural function in the evolution of the work.

However, the importance of Grisey's sentence does not end here; he also points out that to neutralize is to confirm that every element of a group has the same occurrence probability and, therefore, the same quantity of information.[23]

Other examples of masterworks that have opened new possibilities in regard to the neutralization of a parameter are Schoenberg's *Five Pieces for Orchestra, Op. 16*, which is the first to utilize the timbre melody and statism in the pitches, and Scelsi's *4 pieces on One Note,* which is perhaps the best possible example of pitch neutralization.

We could also talk about Cage who was perhaps the first composer to achieve the simultaneous neutralization of all parameters through his techniques of indeterminacy. Also, in terms of the relationship between composer and listener. In Cage’s music, the composer is no longer the central element, thus emancipating the listening from its creator as much as possible.

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[23] According to the theory of the information, the quantity of information carried out by an event is inversely proportional to the probability of its occurrence. Theoretically, all pitches have the same probability of appearing in serial music, which is not the case in tonal music. For example, the tonic and dominant contribute less information than the rest. In some of my works, there are elements that, following this theory, carry out a neutralization among some parameters to others, functioning within a certain hierarchization. The same thing happens in a diverse group of parameters because, if we alter the importance of any of them, it also affects the importance of each in the group.

If we pass from a tonal fragment to a serial one, and we use a series of rhythms, where a rhythmic element has a bigger occurrence probability, and although they are the same in both passages, the rhythmic events in the second one will have greater importance without altering the probability of each element automatically. The same occurs if we have a speech founded on several parameters, each one with its own entropy (i.e., grade of order in the organization of the elements, and a minimum entropy when all the elements have the same probability); the fact that a parameter has a minimum entropy will highlight the importance of the other parameters. There is a type of parametric modulation that I call entropic that occurs during the transition of a passage to another, modifying the entropy of some parameters and causing a change in the parametric centrality. This will be explained in more detail at a later point.

Ways to neutralize a parameter

Time can be neutralized by avoiding the pulse sensation (e.g., works by Feldman, Ligeti), while pitches can be neutralized through their integration into clusters and sound masses, where the individual notes stop being recognized (e.g., works by Xenakis, Ligeti). The pitches can also be neutralized due to a serial unhierarchization, the reiterative use of only one note, or through clusters[24].

A neutralization of the harmonic sense can be generated by avoiding the movement of the chords (i.e., clusters without movement). Ligeti did this by moving from pieces featuring a total neutralization of the harmonic (as seen in *apparitions and atmospheres*) through chromatic clusters to music with a harmonic movement using diatonic clusters with holes (*lux aeterna*).

We can define each period of Western music by considering the relevant parameters. The tendency in the vanguards of the twentieth century was to give increasingly more importance to every musical parameter. On one hand, the development of integral serialism allowed music to reach a paroxysm where all the parametric elements were organized or directed by the same principle, even though some were more important than others. On the other hand, I believe that the biggest contribution made by Stravinsky was to demonstrate that sound speech was possible, in which rhythm, rather than the pitches, was the central parameter. This latent parametric translation was already present in works by some composers such as Debussy or Satie, and led to an immense variety of possible translations, such as the dodecaphonism accomplished through integral serialism.

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[24] Schoenberg also uses the adjective of “neuter” when referring to certain grades of chords. We could then consider "as neuter to this effect the grades III and IV."

Even though parametric neutralization existed before my work, I use it in a novel way, utilizing it just like any other material in the sound speech. While neutralization in Ligeti's, Scelsi's, or Schoenberg's works happens throughout the sound course in the same manner, it doesn't in mine because of this conception I hold regarding the use of parameters in the musical flow. In my music, a parameter is sometimes neutralized and sometimes not, just like a tonal work can be in C for a while and then suddenly modulate to G. This is what I wanted to demonstrate in *Parametric Modulations Studies.* In other words, *the determination flow of some parameters on others is not fixed, but rather change throughout the work according to a certain plan or structure*. Unlike in integral serialism, there isn't a parametrical center, nor a fixed connection between parameters.

In fact, the way in which some parameters are related to others, and how the changes in the determination flows evolve over time, is what actually constitutes the discursive and formal nature of cognitive-parametric music. It is this specific use of the parameters that allows their importance to be unified within the music while at the same time decentralizing the composition in its totality.

Therefore, the neutralization of a parameter can be made in the following ways:

1. **Neutralization by statism**. When a certain parameter remains static without evolving in time, it stops being perceived and lacks importance because it doesn't provide the listener with meaning or new information. *Only the parameters that give new information about what is happening are perceived*; the strategies of parametric modulations act in order to bring into focus the activity of a parameter that moves while omitting the activity of others that remain unchanged. The repetition of a pattern that doesn't change in association with a parameter becomes equivalent. Anything repeated unceasingly becomes static.

2. **Neutralization by becoming meaningless.** When a parameter no longer has importance or when there is a difference in its values that is meaningless in the current context but isn't static. Here is where

Adorno's idea regarding the meaningless qualities of materials becomes relevant; a parameter can gain or lose importance if it changes the pattern of the probability distribution[25] from the elements of a group or if it varies the components of the group. Neutralizing a parameter means that none of its components bring new information and become meaningless. This happens in regard to the difference between tonal and twelve-tone music, as well as in stochastic music. Tonally, the notes can be neuter (i.e., they don't hold information about the tonality) or hold information about it. In both cases, there are one or several functions that assign meaning to each element of a group (the notes, in this case). I will talk more about this in my discussion of signification space.
Contrary to the tonal context, all notes have the same information in an unhierarchized context, which is why neutralization takes place in the tonal meaning of them during the move from a historical tonal context to dodecaphonic historical context. This concept is what Adorno referred to. This process of neutralization of the significant loads of a certain material over time can also be reproduced inside the work itself. Explained another way, a parameter whose group of values loses significance is neutralized. However, a certain material can be defined as significant in more than one way; as we have seen, the meaning is something relative, with the property of the objects settled from outside. Therefore, we can generate simultaneous meanings for a material and make them dependent on other parameters, such as when the signification space of several parameters is correlated. We can also create applications that vary the significance functions throughout time, in such a way that we can obtain a sound flow of complex and simultaneous yet independent processes of meaning in several parameters, which is what defines cognitive-parametric music.

3. **Neutralization for neuter element.** This process is something similar to the application of the neuter element in mathematical or logical operations. For example, 0 is the neuter element in addition but not in multiplication. When we pass from a multiplication context to an addition context, the 0 is neutralized, i.e., it is transformed into the neuter

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[25] Entropic neutralization

element. This is what happens when we say that timbre is neutralized in Bach's music (albeit with some exceptions), or what Schoenberg explains in regard to the functions of the chords to indicate tonality.

This also happens in mathematics when a certain element, a number for instance, is a neuter element depending on the operational context (i.e., the mathematical operation). In a sound context where a certain element is the neuter, its function depends on the formal and structural context of the work; every parameter would be null if a composer didn't take it into account. For example, in a composed work that does not consider the idea of being played with a certain timbre, the timbre becomes a null element because the composition would remain the same regardless of the value (the instrument) used. But in a work by Beethoven, for instance, the instrumentation has a structural character, so we can no longer say that the instrumentation is a null parameter.

The most radical example can be found in Cage's music. If the realization of a concrete random work is possible with independent pitches, durations, and concrete timbres, then we could say that every parameter is null. In works that use space as a compositional element happens in the exact same way (see works by Nono or Gabrielli). But if the composer doesn't use space as a compositional parameter, then it isn't null. We could say that space is a neuter element in the work when it is actively considered and being converted as null inside the work itself. This is, in fact, another way to perform a parametric neutralization.

Cognitive-parametric music considers the parameter concept as constituent of the parameters of the work that are not null. Consequently, in cognitive-parametric music, the parametric thing isn't null.

Another way of approaching neuter elements is when an element is neuter in certain musical contexts; for example, following Schoenberg, the grades of the chords that do not offer tonal information are therefore, tonally speaking, neuter elements. Just as 0 is or is not neuter depending on the operation, a chord is or isn't neuter depending on its tonal context; a certain tonality, in this case. Certain sound materials are neutralized when the organizational context in which they are integrated changes. This is what defines cognitive-parametric music: a changing context of movement, the way in which the musical parameters are related changes and, consequently, how the sound objects are alternately neutralized.

In this type of neutralization, something is neuter when its concrete realization is the same in a given work concept, regardless of the value it takes, or in regard to the significance loads of its context.

This third type can be subdivided into two separate categories:

Neutralization for neuter passive element: a performance of a random work by Cage will be mostly the same thing in spite of the small differences between the notes. In another context, however, such as in Bach's choral music, a chord in a certain tonality can be neuter as soon as it does not provide any information regarding tonality, but it cannot be neuter and bring information about tonality in another tonality. I call this second type **neutralization for neuter active element.**[26]

These models coexist together; while this classification is ideal and an archetype, the two are mixed in actual musical works. In other words, several parametric neutralizations can converge simultaneously and multiple parametric modulations can coexist. The present lists certainly don’t exhaust all the possible forms of establishing parametric neutralizations.

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[26] *Parametric Formalizations Studies* is full of examples of this type, with even the formal operators neutralized in this way.

Information Theory and recognition of Sing's Theory applied to cognitive-parametric music

I'd like to discuss some of the technical and cognitive concepts that can be used to shape any cognitive-parametric work. You will soon see that there are different ways of perceiving something as significant, all of which coexist simultaneously. Cognitive-parametric music depends on this to be successful: the greater the differences in meaning, the more cognitive tensions that occur.
Grisey, Stockhausen, and Xenakis are some of the composers who have integrated concepts of Information Theory into their music.

> Définir a chaque instant donné ce qui change par rapport à ce qui précédé, structurer la quantité de changement, la différence entre chaque événement et le suivant, cette notion issue de la théorie de l´ information fur reprise par Stockhausen (Veränderungsgrad) notamment dans *Carré* pour 4 Orchestres et 4 chœurs. En incluant non seulement le son mais, plus encore, les différences perçues entre les sons, le véritable matériau du compositeur devient le degré de prévisibilité, mieux: de pré-audibilité. (Grisey, *Structuration des timbres dans la musique instrumentale*, *Écrits*, p. 106)

One of the theories that Shannon[27] has developed relates the capacity of a channel to its signal-noise relationship. The maximum capacity of a channel (C) in bits per second depends on the band width (W) and on the signal-noise relationship:

$C = W_{\log 2} (1 + (S/N))$[28]

Therefore, for each communication channel, there is a threshold of noise that establishes the capabilities of transmitting information. As we have seen, the physical thresholds determine how some parameters determine the perception of what is happening in another one, and how this information is used in the parametric neutralizations.

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[27] Second Shannon´s theorem about codification for channels with noise.

[28] See chapter 2 of *Communications and Nets of Computers* of W. Stallings.

Since a sound may mask another sound through this instrumentation, a parametric process can be masked by means of another at a certain threshold of perception. As we will see later, we can create certain parametric processes that make some operations in a certain parameter less important than those in others, ultimately becoming meaningless since the human attention span is only able to process a specific quantity of elements at the same time. If we saturate it[29] with processes of excessive information, listeners will have to choose which one to focus their attention on. This is the main foundation of the creation of several internal channels in the work flow: each time you listen, you have to choose which parametric process you are going to pay attention to (like dialing a channel). Your choice determines the meaning of a process associated to a parameter and how it relates to the process taking place in another. As a consequence, we can make a process in a certain parameter lose its sense of meaning by halting its codification by increasing the noise that generates the process associated to another parameter.

According to Information Theory,[30] the informative content of an object inside a set of objects is the logarithm of the inverse of its appearance probability. In general, the more an event appears to belong to a set, the less information there is to compare it to the rest of elements of the set.[31] We can reinterpret this idea musically by saying that the less a certain event sound appears, the greater chance it has of surprising us when it does occur. This idea has been used in many works where the composers, following this cognitive rule, reserved certain materials for a certain formal moment.

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[29] Although I am speaking here on saturation, I'm going to apply this concept in a very different way than a saturationist would. My music is not saturationist, although I use certain saturations to focus or blur a certain moment of the active processes in a parameter.

[30] C.E. Shannon, *A Mathematical Theory of Communication* (1948). In general, when I speak of Information Theory and about entropy, I discuss it in the way that Shannon conceived it, as something abstract, formal, and logical, and independent of its application field. I will use Shannon's notation rather than the common one in thermodynamics when speaking of entropy. I avoid any isomorphism between thermodynamics and sound. Entropy is only of interest to me in terms of defining the informative (and, therefore, a meaning form) power.

Let us imagine a set of 12 notes, where each (*x*) is a message, and that each message has a probability of being used [*P(x)*]. In this case, the quantity of information is inversely proportional to the probability of that message appearing. For example, if we are in a serial passage, each one of the notes has the same quantity of information since it has (or should have) the same appearance probability. In a tonal passage, the tonic and dominant have a greater probability of appearing and are therefore the ones with a smaller quantity of information. In general terms, we can say that if the probability distribution of a set is uniform, then all the elements have the same quantity of information. If the curve is not uniform, those that have greater appearance probability give less information, while those with less appearance probability bring more information because they are more likely to be surprising and participate in cognitive strategies.

This is what grounds the parametric retards that I have exploited often in my works – especially *in Parametric Modulations Studies* and *Parametric Formalizations Studies* – and provides the foundation for parametric cadences. We can code certain elements inside a group in a special way, eliding them strategically with respect to the rules for how they should appear (e.g., the *B* in the first section of *Parametric Modulations Studies*), so that they hold a great load of information upon appearance; since they are less frequent, their appearance contributes more information and solves cognitive tensions. All of these techniques are applied to the parameters in *Parametric Modulations Studies* and carried out with the dynamics, a specially elided parameter used as a cadential element. A generated order then induces a certain recognition of patterns and deliberately elides an element that the cognitive system is especially predisposed to look for. To better understand the process of creating retards and parametric cadential structures, see *Parametric Modulations Studies*, in which an elision process applied to the notes is used to prepare the same process that is applied to a bigger scale throughout the whole work in terms of dynamics.

This is very similar to what Adorno said. There is not a uniform distribution In tonal music, so there are notes with a greater meaning and less probability of appearing than others. To pass from tonal to serial music is to pass from a non-uniform distribution to a uniform one, where notes that once held more information have now lost their special meaning.

The quantity of information of an event inside a set of events is inverse to the probability of appearance of each event. This means that the greater the probability of the occurrence of an event, the less information we can extract from it.

According to Shannon, the Information (I_i) of an event (x_i) is:

$I_i = - \log_2 (P(x_i)) = \log_2 (1/P(x_i))$

The quantity of information that a system can provide is then measured as the pondered sum of the quantities of information of all the possible states of a certain aleatory variable V:

$$H(V) = \sum_{i=1}^{n} P(x_i)\, log_2 \left(\frac{1}{P(x_i)}\right)$$

According to this formula, the largest quantity of information is obtained when the distribution curve is linear. For example, the quantity of information of a currency rushed to the air is a uniform and lineal distribution:

$H(V) = -((0.5 \log_2 0.5)+(0.5 \log_2 0.5)) = 1$

If we fiddle the currency and make the cross to have more probabilities than the face (60% face) (40% cross), then this is a lineal distribution but not uniform:

$H(V) = -((0.6 \log_2 0.6)+(0.4 \log_2 0.4)) = 0.970$

Musically interpreted, the maximum quantity of information is obtained when the probability of appearance is the same for each note. In this way, a serial system contains a greater capacity for information than a tonal one since the distribution is linear and uniform in serial music, but not in tonal music.

In the same way, integral serialism possesses a larger quantity of information when carrying out the same task on all parameters. In other words, music in which all parameters use lineal and uniform distribution curves generates a larger quantity of information than music that just uses a uniform distribution in a single parameter. For the same reason, if we also serialize a set of parameters, avoiding a single parameter with a centralized and non-lineal distribution, the parametric serialism will have more information power than serialism. This is only a theory, however; as we have seen, this is only relative to a statistical internal property of the system, so we cannot refer to semantic or semiotical questions that are external properties to the system and settled from outside. But what is interesting it to consider both forms of evaluating the work as a system, i.e., the internal statistical properties and the possibility of interpreting them semiotically. This will be explained in greater detail later.

The quantity of information of a system (in our case, a flow of sound events) is opposite to the order of this system. The entropy of a group of events is a parameter that defines the level of order, and therefore has the possibility of obtaining knowledge (meaning) of the other elements starting from the one given in a system. That is why we can study the attributes of the group of events in two different ways: as the macrostate of the group, which is the total average of this attribute in the group of events (e.g., the average of a population's age, the average temperature of the molecules, or the average of the appearance probability of each one of the notes in a musical system) or as the microstate, which analyzes and defines the group by the value of each element that forms it.

Let us imagine a class in which all the students are the same age (20 years old). In that case, the macrostate (the average of all ages) would be 20 and there would be only be one microstate, where each student is 20 years old. This group has the maximum entropy.

But let us now imagine a class in which all but two students are 20 years old: one is 21 and another is 19. In this case, the average continues to be 20, but we now have a larger quantity of possible microstates. In the former scenario, we only had to know the age of one student to know all of their ages, but that is no longer possible. We now have a less orderly group with smaller entropy.

In the first case, knowing the age of any person indicated the same information, but there are certain people in the second example whose age allows us to discover more; they bring more information, so they are more significant.

Therefore, we can arrive at certain macrostates through different microstates.

If a certain system has only one possible microstate, it is highly orderly, since it is possible to know the value of the rest by knowing the value of one element. In other words, the more possible microstates the system has, the more minor the order and greater the informative power of the system. However, as we have seen, a certain level of disorder allows certain elements to become more significant. Cognitive-parametric music is based on, not so much the process of looking for an order, but rather the ability to look for strategies that allow us to assign a privileged meaning power to certain elements. The meaning power is different from the informative power: the latter is a statistical property and is internal to the own system, while the former is something that it is put on the latter from outside, assigning itself a semiotical meaning from a third external element. The order is inverse to the possible number of microstates, contrary to the quantity of information that is proportional to the number of microstates.

Information Theory gives us the ability to understand the significance of a certain specific element and understand the information that such element carries regarding the events that will appear in its presence. But, as we have said before, this is only one way of understanding how something becomes significant.

However, a system with a microstate is equivalent to a tautology and is therefore meaningless; a highly disordered system is equally meaningless from the perspective of the meaning power. Some values that are neither very high nor very low in terms of entropy allow us to obtain the largest signification spaces. This rule allows us to understand that, in general, cognitive-parametric music looks for systems with intermediate entropy. Unlike informative power, which deduces the value of other elements by starting with a single one, meaning power indicates the multiple and simultaneously different ways that one can say that something is significant. The power of cognitive dissonance is based on these multiple ambiguities. A system with a microstate or one that is particularly disordered cannot produce any cognitive tension. We can find the greatest power of cognitive tension in the intermediate values of order.

We will see this later in more detail, but let us briefly imagine a fragment of the concept with only one note: the beginning of Ligeti´s *cello* *concerto*). The notes are very orderly, but they don't tell us anything about the speech flow. In this case, the entropy and the signification space are opposite of one another.

In tonal music, we have more microstates and therefore a smaller order, but there are notes with great meaning.

In a passage of serial music, the probability of every single note appearing is the same; we also have the largest number of microstates and therefore the possible biggest disorder. However, it is totally meaningless; in contrast with the tonal example, no note has a particularly special meaning in this case.

It is important to differentiate among the quantity of messages that a communication system could have from the informative power (the capacity to generate information and the significant power (the capacity of a system to produce the biggest significance loads, sense loads), as well as the possibility that the weight of certain information varies with another parameter (signification space).

In fact, cognitive-parametric music is looking for a certain material that has meaning power that can vary in function with another parameter. For example, if we pass from a passage in which every note has the same appearance probability to another in which two notes can only appear, we thus pass from a passage in which all notes have the same significance to another one in which certain notes have more significance, as if the importance of the information that notes bring has changed in time (definition of signification space).

We could say that the importance of certain notes changes over time; however, the same can be said about any combination of parameters. Here we have the power of conditioning the significance of any parameter over another by means of not having any privileged parameter, hence the purpose of cognitive-parametric music. In this context, informative power and the quantity of information is reached and maximized. It is important to precisely differentiate between the quantity of information and the importance (meaning) of the information: cognitive-parametric music attempts to maximize both through intermediate order states.

To elaborate parametric neutralizations it must be changed from one moment to another at the same time (*Parametric Neutralizations Studies)* the curves of probability distributions of one or several parameters at the same time. The change in probability distributions in each parameter causes a change in the quantity of information that contributes to a parametric modulation (entropic modulation). In cognitive-parametric music, the entropy of the system is meaningless; the indication that an orderly system is better than a disordered one depends on the context. An entropic modulation doesn't imply a transition from an order state to a supposedly superior one; it only implies a modification in the order grade. In fact, the three studies progress more towards disorder. In cognitive-parametric music, there is not any order state considered central or that generates a certain tendency or works as an attractor: all the possible states of order are equally important. In cognitive-parametric music, time arrows do not exist. What we are looking to do is to condition the meaning (the signification space of a parameter) to another one by establishing determination flows. In fact, it is possible to accomplish a parametric modulation in which the entropic level is the same before and after the modulation; for example, if we have four parameters and each of them has its own curve of probabilities distribution, we can change the entropy by modifying these curves; however, if we change the distribution curve throughout the parameters, the entropy will remain the same. The meaning takes place with respect to a change over the privileged parameter.

For example, we can have a fragment in which three parameters have a uniform curve of distribution and another parameter without. As long as those same events (the ones in which the parameter with a non-uniform curve holds one of the values with less appearing probability) are more significant, listening can be conditioned to associate the meaning of any other parameter to the one with a non-uniform distribution curve. If we change the distribution curves in such a way that the parameter that has a non-uniform distribution changes, a parametric translation undoubtedly takes place, which thus indicates a parametric modulation (as seen in *Parametric Neutralizations Studies)*. The meaning of a parameter is lost (i.e., becomes neutralized) through this parametric modulation; the parameter with a non-uniform distribution curve has more informative power, so it can condition the significance of the others. In Scelsi´s music, for example, in which we find few notes with a high probability of appearing, these notes won't have any significance load or contribute to new information. Although highly organized, they are completely neutralized.

Therefore, only by varying the distribution curves of the appearance probability of some events in the work, we allow them to become significant (or insignificant). This is the basis of *Parametric Neutralizations Studies* in which the statistical distribution curves of each sound parameter in each fragment are modified, and where the musical form is defined for the variation of these curves. Xenakis' music is one of the most important precursors to cognitive-parametric music; he is considered the first composer to use statistical distribution curves (although he considered the properties of sound as variables and vectors instead of parameters).

In cognitive-parametric music, there are not only different distribution curves of probability for each parameter throughout time, but also *a changing the distribution of several different distribution curves on the parameters throughout the work.*

However, the cognitive-parametric music, the events follow distribution curves, but they are not aleatory; rather, they follow rules derived from cognitive models. In cognitive-parametric music, the meaning of a parameter is conditioned by processes on other parameters, while Xenakis's stochastic music has more control over the step from the continuity to the discontinuity using probabilistic processes as a way to critique the linearity of the integral serialism. Xenakis generates a sound mass by changing densities that are regulated. In cognitive-parametric music, the informative power is used to facilitate or to hide the recognition of patterns (on the same objective material) and to generate cognitive dissonances derived from the multivalue of the material's meaning.

Thus far, we have discussed how to define the meaning of a material by means of its informative power, but we are now going to see that there are other parallel and simultaneous modes of defining meaning from other points of view, and that the significant power is the sum of all the possible ways to say that a certain material is significant.

But first let me explain this more slowly; as we have seen, the application of Information Theory to tonal music indicates that the more repeated notes hold less information. In other words, if we are in *C, G* and *C* will be the most repeated notes, but will provide the least information.

However, this has a double reading, as Schoenberg has shown us. From his point of view, they are the most significant in establishing the tonality and they provide ample information regarding the current moment, but they are the least significant in terms of the sound flow's forthcoming direction. However, if an *F*-sharp appears, it unequivocally announces a modulation, i.e., that the smaller appearance probability will indicate significant information on how the sound flow changes. Therefore, we can establish a cognitive law based on the aforementioned explanation: *The greater the probability of an appearance of an event, the more information in provides in regard to the current moment and less information about becoming; or vice versa, the smaller the probability of an appearance of an event, the more significant power it holds on what will come, but less in regard to the current events.* Music is not an abstract set of elements, but a system that moves throughout time. Hence, it is important to differentiate the information of a static system from another whose distribution curves of probability are modified in time. In this sense, the importance of speaking is increased, not only in regard to the quantity of deducible information from one element to another, but also in the difference between the quantity of information of what happens in the current moment and the quantity of information of what will happen next.

Events that appear less have a greater capacity to surprise and more power to create cognitive dissonances. The sound elements most frequently repeated make it easy for listeners to the recognize their patterns. This means, however, that these elements are the most significant from a harmonic point of view since they provide a significant amount of information about the current tonality. Therefore, different simultaneous forms in which such sound elements are significant or not coexist in the same flow of objects. In fact, there is a possibility in this multisignificativity to render a significant something insignificant without modifying its quality as a material. It is thus only necessary to alter the context, so that the context, or the relativity of listening, determines which one of those significant elements is being focused upon by the listener.

In other words, every time that the supposed centralities of a parameter onto another are smaller, the distribution of the meaning power is more uniform, which is exactly what Adorno indicated.

The process of abstraction and indifferentiation creates a bigger informative power (which is yet another concept parallel to Adorno's).

Nevertheless, there is not an isomorphism between Adorno and Information Theory since Adorno in fact never speaks to us from the perspective of information power but rather from that of signification power.

We see then that Information Theory and Adorno’s theory converge here on a basis of cognitive-parametric music. The biggest grade of abstraction, which is generated when included with a parameter concept such as musical material, becomes more meaningless in terms of the sound materials, thus implying an increment of the power of the work as a system of information.

What has already been explained in reference to the domain of telecommunications is also applicable to the domain of psychophysics, albeit with certain modifications. The psychological theory of signal detection[32] designed a model that studies when an ideal human detects a certain sign or not. In this model, the detectability of the sign depends not only on the signal-noise relationship (described earlier in this chapter) but also in the *a priori* probability of the appearance of the sign. In a different way than Information Theory, the probability that an ideal entity detects a sign within this context is proportional to the probability that this sign is given. What interests me for my musical purposes is the impacts or costs of a mistaken decision within the models. Otherwise, detecting a sign carries a high cost (a punishment), meaning that the lightest sign of suspicion will be interpreted as a signal. If what is being punished is the positive detection, only the signals that are absolutely correct will be detected; in this model, we find *a decisional component* that maximizes successes or minimizes shortcomings *a priori* in terms of the function of their cost. In our case, this decisional component is conditioned by the success associated with the recognition of patterns. In other words, listening will focus on detecting the signs that allow us to recognize a larger number of sound regularities (this is the basis of the positioning concept of listening, which is always intentional).

Now, Information Theory indicates the quantity of information that a specific message can hold, but it doesn't specify how it is decoded from a strictly musical point of view in the listening moment nor the meaning of this message. So, if we keep in mind that the set of messages is formed by two notes and their respective probabilities in a musical speech, then Information Theory should give us a measure of the quantity of information that an event can hold, but this is more than just the musical information; whatever the information is also contains a meaning load of an event. As we have seen before, Information Theory is adapted to predict a modulation to a new tone. If we wanted to extract information from a set of messages of two notes, one being the current tonality, we would have to look for notes at a fifth or fourth interval away that are repeated more often. To only extract musical information, Theory of signals detection is more appropriate than Information Theory, although we know working with both theories simultaneously can produce a great range of formalizations. The intentional component that implies the psychological theory of sign detection facilitates more types of cognitive considerations and adds new forms of meaning retrieved from music flow. It is the overlapping of these different logics, applied to the sound flow, how an integrational threshold exists, that determines how they work together. This overlapping also facilitates and provides the foundation for the multivalued meaningless. However, in addition to my consideration of the informative power of the events in function of their appearance probability, I also look at their cognitive recompenses derived from the satisfaction (or dissatisfaction) of a certain pattern's recognition (cognitive dissonance). This leads to the idea of *listening positionality*, in which the detection of or focus on a certain element works in tandem with the ability to obtain the prize of recognizing certain patterns. When I say that listening is positional and therefore relative, I mean that listening has certain directional components that are intentionally determined.

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[32] See chapter 2 of *General Psychology* by Grzib and Briales.

Therefore, we can create a second cognitive rule that both relativizes and expands upon the previous one. The idea that we obtain a greater lack of meaning in regard to sound materials and more increments of power in the work (like an information system) by including the parameter concept as musical material can be relativized by applying the multimeaning derived from cognitive models with decisional components that are unaware of the informative models.

The relationship that exists between the increments of the meaning power by integrating the multiple ways of considering the informative power and the possibility of generating cognitive tension is essential to making a cognitive-parametric work.

In this synergy, cognitive-parametric music has thus found a shortcut to generate the greatest power of cognitive tension, with the possibility of creating a sound flow through such tensions. An intentional component associated with the recognition of patterns in included in these tensions, as well as a grade of tension and relaxation that errs on the side of the listening and is never placed in the compositional fact itself. Music gains with it none-alienation.

The signification space

We will now part from the idea of an abstract space concept as something that doesn't preexist, to a thing that is determined *a posteriori* according to a perception that interprets the facts of such a concept.[33]

Basically, space is something that accompanies entities that have a position and therefore have a distance between them. For example, two or more points at a certain distance from one another imply the existence of a space. However, this space and the distance among the points do not have any significance per se; it is only when the space is observed by a third party that such significance occurs. The distance thus acquires a relative sense to an entity that takes a certain position in regard to the primary points.

For example, imagine three cities: London, Paris, and New York. First, a physical, real, and objective space exists in which the three cities are all included, but there is also another space that indicates the significance of the distances to another entity. In this way, the distances are perceived differently through time; a citizen from the 17th century will perceive it differently from us since we can travel between the cities in a few hours, while their travels took far more time and space/distance was then perceived differently. Distance thus loses its meaning in relation to the speed and the social cost of overcoming is: this space is the signification space.

A distance, then, can be identified as the time that it takes us to travel through it. An example of this in relation to the historical process is parametric neutralization regarding the way in which technological improvements in transportation have impacted and made the signification space of the physical distances seem shorter or smaller. It is also a fact that a physical distance walked several times is perceived as shorter as well, as it loses its subjective meaning each time. The physical distance can add or subtract extra meaning regarding the function of the developmental state of the means of transport, conditions of the person, etc.

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[33] It must be clear that it is not my intention to say that everything exposed here is always valid in all the possible applications of the space concept, especially in the context of physical space. Rather, I speak from a concept of semiotical space that exists prior to any application.

The signification space is used to establish parametric inter-definitions; this is especially important in cognitive-parametric music and is broadly used in *Parametric Modulations Studies* in which the inter-definition of the parameters through the signification space is used as a common element to carry out the parametric modulations. We can find another similar case in the current society, where physical distance loses its meaning because of technological advancements.

Parametric inter-definition

Being aware of what has been exposed before allows us to inter-define the parameters due to their significance. The significance of the physical space can be defined by means of another parameter, e.g., the space by the time that it takes us to travel it. The meaning of the physical space decreases with the improvement of the means of transport. We can then say that the social meaning of the physical space is an application of meaning depending on the improvements of the means of transport. That’s why this meaning function allows for the inter-definition of one parameter to another, with the complexity of reality in mind.

Let us imagine that the development of the means of transport is paralyzed by the shortage of a certain fuel. At this time, the transportation won’t affect the length but the shortage of fuel will add meaning to the physical distance: the distance won’t be measured by the time that it takes for the trip, but by the cost of the fuel. This process in which a parameter is substituted by another when defining the significance of a certain parameter is called *parametric translation* and is the foundation of parametric modulations. The signification space allows the conditioning the meaning of a parameter by another through the meaning application operationally defined by the inter-definition of both parameters.

The parametric translation means that the meaning functions become more complex. We can understand that a parametric translation is a function of meaning functions in time. In other words, like a function that assigns, in function of a parameter, how another function will determine the signification space of a certain parameter.

But things can get extraordinarily complicated if we keep in mind that none of these parameters are privileged in regard to the others, and that the one that is now decisive can become determined (inversion of the determination flows). A central perpetual parameter does not exist.

Let's look at an example. Let us imagine a society of abundance, where there is so much fuel that the means of transportation are developed extremely fast. This context will make time the most significant and important parameter, while the others are dedicated to its service. However, things can change and the exhaustion of the fuel can mean that time loses its importance; this loss thus becomes the most decisive factor, producing an inversion in the determination flow and therefore a parametric translation.

The signification space is good for inter-defining some parameters in function of another according to a certain context. A formal structure of cognitive-parametric music is a formalism that creates a variable context in such a way that the different parameters are inter-defined through continuous parametric translations.

The world in which we live makes constant changes that imply parametric translations. The economic crisis alters the context and determines a great number of parametric inversions. When the wealth is enough, the rest of the social forces are focused on solving other problems, but when it lacks, everything works to its service.

The technological advances are also a great source of parametric translations, and the evolution of art itself can be explained through the modification of the social context in which it acquires its meaning.

Class conflicts, or anything that works as an engine of historical change, are also great determinants of parametric translations.

History[34] teaches us how what was central once will not be so the next day, year, or generation. Perhaps the birth of cognitive-parametric music reflects these times of big convulsions and regressions, times where we have seen and experienced a changing context in which a lot of parametric translations have occurred.

The idea for cognitive-parametric music is born, in this sense, from modeling social reality as a series of determination flows that are inversed and changing continuously without a real center. The control and alienation techniques are based mainly on false inertias of establishing determination flows on false centers. That's the reason why cognitive-parametric music was born as a unalienated music, with the pretension of neutralizing these inertias.[35]

Another example that is exclusively linguistic is the case of colors. There are tribal languages in which the differences among colors are not significant, so few words are created to define the different colors. In other languages, however, where the importance of the differentiation of colors is greater, many more terms are created to describe colors. Therefore, when the differences inside a space are more important or decisive, a bigger expressive richness is generated; in other words, the signification space is bigger. We have also seen that the signification space is remarkably relative: the ability for differences to hold meaning in function of something else is external or due to the historical process.

Musically, we can find an example of parameter inter-definition in spectral music, in which the pitches are inter-defined by the sound spectrum.

In Nono's music, we can find another example that is a bit more metaphoric: his multiple speculations on space that go beyond the use of the physical space as a parameter in the musical composition. Nono thought about musical space as something that went beyond the physical time-space conception. In fact, his reflections about it were what inspired me to define the concept of signification space.

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[34] In Foucault's work, he exceptionally examines this critical perspective from many processes of this kind.

[35] For further information, read the following texts of mine: *The Confrontation Myth and Political Ontology*; *The Intentionality of Methods,* and *The Epistemic Possibilities of the Rizomatical Systems Against the Ones Based on Determination Flows on a Centrality.*

Another inter-definition example can be found in Stiebler's writing, when he speaks about Feldman:

> The extremely sophisticated shifts in his chords [at a] generally slow tempo create the spatiality of sound that [follow] the Wagnerian model ("here, cheat becomes space"), combine[d] with tie: to composed it cheats [the way in which Feldman always] remains the master, in contrast with John Cage, who, in his randomly generated compositions, deliberately leaves cheats up the freedom of listening (…) The spatial quality of his music (always referring to Feldman) which allows listeners to feel the plasmatic mobility and variety of space (this is also to question of sensitivity and the awareness that forms from it) and above all the hovering character derived from the rhythmic structure conveys the bottomlessness, the palpable lack of gravity that could be observed on the moon (…) In this bottomless space in which distances, speeds, and durations become relative. (Stiebler, "Feldman's Cheats," mentioned in *Feldman in Middelburg*, p. 18)

Therefore, a parametric neutralization consists of considerably nulling or diminishing the signification space of another parameter.

We can consider the signification space like a function that specifies the evolution of the significance of a parameter in function of another decisive parameter. The decisive parameter is the one that conditions the meaning of a determined parameter. If we keep in mind the previous case, we can interpret the loss of significance of the physical space as a significance function that assigns a signification to the physical space by function of the time and progress of the means of transportation.

We have seen in an intuitive way, as represented through the signification space and applied to the number of colors, that the significance of a certain difference is determined by certain aspects of a particular language. The signification spaces determine the form in which the languages and their evolution are constituted through time.

As I have shown in other writings, modeling the social reality around a parametric model in which any parameter can play the role of a center and where any centrality doesn't exist (contrary to Marxism or classic structuralism) allows us to avoid the inertias that over-determine and reify certain objects with a significance load: to avoid overdetermination is to unalienate.

From strictly a musical point of view, a signification space comes associated with the difference in structural and musical importance between two values of a parameter. In this way, to neutralize a parameter, regardless of the difference between two values, will equalize the significance. For example, a certain interval can be substituted by any other without losing the sense of the speech. A neutralization at a perceptive level implies that this parameter's existence is no longer perceived.

We can use the modification of the signification space of one parameter by means of another to inter-define these parameters. The inter-definition of parameters, through the signification space, can be made using a liminal model (as seen in my new work in progress, *Three Chants for Computer,* and the rest of my electronic music, *Sound Stain - Sounds to Occupy Impossible Spaces* and *For Rachel Corrie*), by means of a cognitive model (such as the gestural cognitive model I employ in *Parametric Neutralizations Studies*), by an induction through a correlation of signification spaces (as seen in *Parametric Modulations Studies* and *Parametric Neutralizations Studies*), or by means of other methods.

An induction through a correlation is based on the idea that placing an object centrally inside a system generates an inertial tautological significance on the other objects of the system, which is an overdetermination (see my text of *The Intentionality of Methods*). In summary, to put something as the center induces some significance loads. Thus, putting a parameter as the center in sound speech induces some significance loads on the other that can be used (they are used, in fact) to establish parametrical inter-definitions.

The parameter concept as musical material

The last foundation of the cognitive-parametric music as I conceive it is the use of the parameter concept as another musical material.

We are going to see it through the study and definition of the concepts known as parameter and musical material.

The use of the word "parameter" dates back to Grecian times; parameter (παραμετρέω) appears, for example, in Claudio Ptolomeo's writings, and referred to the meaning of measure or measuring relative to another thing.[36]

Logic uses this word to designate one of the components of the formal first order of languages, the others being the variables and logical constants. *The parameters are the names of the constants, functions, and predicates or signs*. In mathematics and other fields of science, a parameter means a very different thing.

In general, when I say parameter I refer to its logical meaning. In logic, to distinguish something from something is to assign it a predicate (a parameter). So, describing an object means assigning it some predicates. We can say, for example:

The table is red.

In logic,[37] such an enunciate is referred to as "atomic enunciate" and is formalized as *Pa,* where *"a"* is the object and *"P"* the property. Therefore, "*red"* is a predicate that is assigned to the object *"table"* and therefore is a parameter.

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[36] See the entry on "parameter" in the *Dictionary of Logic and Philosophy of Science* by Mosterín and Torreti.

[37] The explanation given here is necessarily pedagogical and simple, and it does not keep in mind the derived problems of the extensionality and the intensionality, nor the other metalogic problems that can be derived. Obviously, the complexity of the problem is by no means exhausted with what it is said here, especially when the thing becomes so complicated in the second order of formal languages.

There are special enunciates called “tautologies” in which the predicate consists of establishing the identity with the subject. For example:

A table is a table.

This kind of atomic enunciate has the property of being absolutely certain, but comes at a high price because it doesn’t tell us absolutely anything about the object, and is thus completely meaningless.[38] Therefore, an entity is defined by all of the things that can be predicated about it. However, it is not possible to apply some predicates to certain objects. For example, we cannot say that:

The G sound of the fourth violin string is red.

To put it simply, sounds do not have an attribute of color.Therefore, objects are described and parameterized[39] by their properties. Intuitively we can say that an object is defined by those properties that can be said about it or that can be predicated on it. Intuitively, we can see that parameterizing an object is to enumerate the set of properties that do characterize it.

For example, if a sound does not have the *property of color*, the parameter *color* will not be part of the parameters that define it. Parameterizing an object is to enumerate the parameters that describe it.[40]

Xenakis[41] was the first composer to formalize the sound objects around their properties (variables for Xenakis), doing so by assigning four properties to the sound objects: pitch, duration, timbre, and intensity. Hence, Xenakis' music is one of the main precursors of parametric music. For Xenakis, a musical object can be defined as a vector of four variables like this:

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[38] As we will see, the problem of the tautologies is very important in regard to its relationship with the lack of meaning; it is thus a paradox in which the more absolutely certain object does not tell us absolutely anything about reality. This is something I use frequently in my music, but I will discuss it in more detail later.

[39] In other fields of knowledge, parameterize means something very different.

[40] I will not tire of repeating, time and time again, that all that is said here has a pedagogical function. It is obvious, for those who know and want to know about these things, that what is said here by no means exhausts all the ways in which we can discuss how something is parameterizable or how the concept is used in science.

[41] Xenakis himself makes it clear that any formalization is an election as arbitrary as any other. The musician’s intentions are what give a formalization its meaning. This definition is found on page 23 of *Formalized Music*.

Musical event = {pitch, duration, intensity, timbre}

There is more than one way to parameterize an object. As we saw earlier, Bach, in his *Well-Tempered Clavier,* only approached the sound objects from the perspective of duration and pitch, and not from timbre or intensity. Thus, for Bach, a musical note was defined by:

Musical event = {pitch, duration}

Nono, however, didn't only think of sound as an entity formed by the same properties as Xenakis: he also conceived it as located in a space. In this way, to such a degree that there is a relationship between listening and the listener's space position where the sound takes place, listening is relative to the listener's position inside the space in which the music is being played. That's why Nono's music is one of the precursors that convey the concepts of listening relativity and positionality , as well as the idea of listening liberation, for which he is another of the cognitive-parametric music big precursors -with capital letter-. For Nono, sound was:

Sound event = {pitch, duration, intensity, timbre, the listener's position, position of the sound source, space where the performance takes place}

Electronic music and the instrumental extended techniques allow for more complex parametric systems. In the work I am composing now, I use a matrix of 24 parameters (*Homo Homini Lupus*), which is possible in electronic music through a complex synthesis system. Each sound event is parameterized through 24 properties. Instead of writing sounds as durations or dynamics, some composers have created notation systems that define the physical actions that the interpreter should carry out on the instrument, which is considered a physical system that produces, through the physical actions written by the composer, some determined sound objects. In other words, it functions like a system that has an input (the interpreter's actions), a processor (the instrument as a physical entity), and a result (a group of sound organized objects). The sound events are parameterized by the actions that produce them; for example, the position of the arch on the string and its pressure are parameterized, rather than the result (even if it is predictable in some cases). *Pressure* from Lachenmann is an extraordinary example of this, although it should be noted that I've interestedly mentioned his idea differently than he would; Lachenmann may conceive of his works differently, but his idea had a great impact on my music.[42]

Thanks to electronic music and how sound objects have been modeled in it, as well as to the reinvention of traditional instruments, we find examples of a wide variety of ways that parameterize sound objects; almost each work's concept requires a parameterization that, on many occasions, is exclusive to that particular work.

Music's progress does not only reside in the expansion of the number of parameters: certain reductionist models can also be equally revolutionary. For example, when spectral music defined the pitches by the sound spectrum, conceiving these two properties as inseparable, it opened more doors than other expansible models like the reductionist themselves. For spectralism, a sound is:

Sound = {sound spectrum, duration, intensity}

Integrational models are essential to cognitive-parametric music since they have settled down an interrelation between all musical parameters; from this perspective, cognitive-parametric music is not even original, so to speak. Such interrelation through those models provides the foundation to the idea of the parameter concept as sound material.

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[42] I have already said in the foreword that I speak on certain composers whose ideas and musical techniques have influenced to me and piqued my interests, but that they didn't necessarily think of themselves or their music as I speak of them; it is likely that they did not compose their works in the manner in which I describe them.

In this way, Feldman never used integrational models consciously, but when I analyzed his works as if he did, I have found things so fascinating that I am sincerely indebted to him. The same is true about the things that I say about Nono, Feldman, or Reich: by analyzing and thinking about their works exclusively from my own perspective, different from the ones in which they were created, and without the concern of musicologists or analysts, has provided me with models and very profitable ideas.

> Up to now the various elements of music (rhythm, pitch, dynamics, etc.) were only recognizable in the terms of their formal relationship to each other. As controls are given up, one finds these elements lose their initial, inherent identity. (Feldman, *Give My Regards to eighth Street,* p. 35)

Therefore, the identity of a sound object does not only depend on how it is parameterized, but on the formal relationships established among the parameters through certain models. *Hence, cognitive-parametric music uses models that characterize the quality of the sound objects in function of the meaning of other elements, or by their relationships with other parameters*.

Grisey goes further and affirms the following in his characterization of liminal music:

> Liminale, parce qu´elle s´applique à déployer les seuils où s´opèrent les interactions psycho-acoustiques entre les paramètres et à jouer de leurs ambiguïtés (…) On y découvre un tel tissu de corrélations que la notion même de paramètres définis et isolés par la musique sérielle semble caduque et inapte à rendre compte des phénomènes sonores. (Grisey, *Écrits*. p. 44–45)

According to Grisey, the perceptive relationships among the parameters are such that it is absurd to seek a formal isolation among them. Hence, I agree with Grisey and I follow him in the idea that we can use psychoacoustic cognitive integrational models as they relate to our perception of them. However, – and here I am not following Grisey – integrational models that do not follow these rules can be settled down. This has been especially exploited in my electronic works and they constitute the physical foundation of parametric neutralization.

Cognitive-parametric music is not only characterized by its definition of a sound event for a series of parameters but its creation of a model that defines how the sound events change, over time, the relationship among the parameters, which is contrary to the work of Feldman or Grisey whose integrational models are static in time. Such a model also allows the lack of meaning of certain parameters to be specified in relation to others (the definition of parameter according to Ptolomeo[43]).

Therefore, in cognitive-parametric music, a sound event is characterized by the parameters described, as well their meaning in relation to others.

As a result, a sound event is always described by the traditional parameters and its contextual relative relationship to the others by means of a matrix that represents the meaning of a parameter in regard to others, which, at the same time, is defined by means of an integrational model that evolves through time.

This leads us to the idea of a meaningless matrix, which specifies the form in which a parameter loses its meaning (it is neutralized) in function of another (i.e., we can see that some of these matrixes don't have a mathematical meaning), as seen in the analysis of *Parametric Neutralizations Studies*.

	First subsection rehearsal letter J	Second subsection rehearsal letter K	Third subsection rehearsal letter L
dynamics	-	-	+
pitch	+	-	-
timbre	>	>	>
time	-	+	-

Example of a meaningless matrix in *Parametric Neutralizations Studies.*

Now, we are going to describe or characterize the material concept. First, it should be recognized that the material is not a parameter, nor does it coincide with the parameters, since, for example, it would not true to say that Bach composed with pitches and durations, because what he in fact used were melodic and harmonic structures as materials. There is also a component of the sound flow that we have not yet spoken about yet: the form.

We can formally define sound materials (relative to how the composer conceives the work) as the elementary units that are organized. There is not a universal definition for what a material is. For example, to Schoenberg, a row is a musical material, but not to Monteverdi; a modulation is a musical material to Bach (in the sense that it is a formally ordered element), but not to Boulez. In fact, Cage imploded and dissolved the material concept completely in his aleatoric works. Furthermore, classification of noises distributed in instrumental families is a musical material to Lachenmann, but not to Mozart. Certain rhythmic structures can be a musical material to Stravinsky, but not to Scelsi. A melody of timbres is a material to Schoenberg and Scelsi, but not to Mahler. And so on.

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[43] In fact, this is the authentic meaning of my use of the term *parameter*: measuring with relation to another. This is the native Greek concept that implies a relative measure of one thing to another.

You cannot characterize a material without keeping in mind how it is inserted. Therefore, we can consider the material as the minimum group of sound events with a formal meaning, and we can characterize a musical form as the organization in time of those basic units, either by their variation or by their contrast. Moreover, since the same qualities of the material define its formal possibilities, a melodic material will be considered in a very different way depending on whether it is going to be integrated into a fugue or in a sonata. The materials are chosen according to their function.

There is a historical tendency toward a growing abstraction in the concept of sound material: silence itself is now even a material. Such brilliant composers as Nono or Cage have accomplished an apparently “impossible thing,” which is to make it possible that silence itself can be music, and therefore a material. Noise is already part of the palette of sound materials, thanks to teachers like Schaeffer or Lachenmann who know how to organize them into formal structures.

Cognitive-parametric music creates small formal units that are defined by how some parameters lose their meaning in function to others. For example, the first events of *Parametric Neutralizations Studies* are based on a gestural matrix that specifies how a parameter is meaningless in relation to the others. And insofar as integrational models define (1) how the relationships among the parameters change through time, and (2) the way in which some alternate parameters are determined by others in the flowing of the work (in front of fixed integrational models created by composers like Grisey or Feldman), the generation of small units will be defined by this parametric structure and become parametric units themselves. (In *Parametric Neutralizations Studies,* each rehearsal letter corresponds to each of these elementary materials, while *Parametric Formalizations Studies* is even much more complex.)

A parametric modulation or scales of parameters are base materials in cognitive-parametric music. Furthermore, these materials are chosen to be inserted in a formal structure that settles how the parameters are related in a changing way. As a result, certain parametric objects constitute the base material for cognitive-parametric music. Likewise, the materials that are not themselves parametric objects are chosen by their parametric qualities concerning the integrational pattern that parameterize the sound objects, as well as the whole conception of the work.

And insofar as the form of a parametric work is defined by the way that parameters are related to each other, thus employing the meaningless matrix, we can say that the parameter concept is part of the material work. On the other hand, in cognitive-parametric music, the form is a function through time that is assigned in each temporary instant to a certain parameter or a group of them to determine the significance of others. In other words, in the parametric form, the parameters are the basic organized elements that are treated as a musical material. The parameters are used to form the base unit of sets, like scales of parameters which are themselves also constructive elements of the form. This abstraction on the material concept that implies the use of the parameter as sound material is consistent with the evolutionary tendency toward the material's abstraction.

Many traditional materials like the melody, scale, series, modulation, or retard have their abstract correlate applied to parametric materials. If a melody is a material, then a melody of timbres or a melody of parameters can also be materials. If a scale is a material that determines that the notes that are formed are musical materials, then a scale of parameters determines that its element (the parameters) also become sound material.

In conclusion, there are two ways in which we can say that a parameter is a sound or musical material: (1) as a main element in the formal organization (as a macroscopic element), and (2) as an element that is used to form bigger units (as a microscopic element); both respective roles are interchangeable.

Cognitive-parametric music is built through several non-hierarchical strata, by means of which the parametric microscopic elements are organized in groups of another level. As I have said, these levels are non-hierarchical in the sense that a level is superior to other; this is because it is the micro-material that sometimes determines the work, and not in the other way around.

One of the intentions of this group of three works is to abstract the quality of certain musical materials, reinventing them in a more abstract parametric dimension. Earlier, we demonstrated how a certain material associated with a certain parameter (e.g., the scale to the pitches) can be abstracted from a parameter and applied to any other. Schoenberg was the first composer to make this possible when he applied the melody concept from the pitches to the timbre; when he included the parameter concept in a similar manner as musical material, parametric melodies could also be created. A melody,[44] series, tonality, or parametric scale is not heard in the same way as its standard correlate, but such is the intention. The parametric material cannot be listened to and perfectly noticed in a serial music context, where there are clearly differentiated materials that differ from the tonal context, but I am convinced that people, in an indirect manner, will intuitively know where a parameter ends and begins in any section that is parametrically defined.

As I have said in another part of this text, cognitive-parametric music is characterized by approaching the parameter concept like a constituent of the not null parameters of the work. This is another reason that it makes sense to say that the parametric is constituent of the material of the work. In this sense, a space in Bach's work that is not kept in mind as a parameter is thus a null parameter. In cognitive-parametric music, the parametric concept is kept in mind as one parameter more in the work; in *Parametric Neutralizations Studies,* for example, each object or basic unit is determined in function of the neuter and the active parameters at that moment.

You could object by saying that the parameter concept is not part of the properties of the sound by itself, which is true indeed, but there have already been many composers before me that have demonstrated how we can use certain materials that do not use part of the properties of the sound as a formal constructive material. Nono used the space as sound material, Cage used the silence as material, and Reich used phases. To compose music by organizing the actions on the instruments rather than on the sound itself is something that was already being done. And insofar as the music differences that exist among the sound result in the current, the listening, writing, and structural layers verify, more than ever, the divorce between the sound material and the properties of the sound. You cannot consider these materials as part of the properties of a sound, but they are still somehow part of the palette of materials that anybody can use whenever they are needed.

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[44] My use of the term “melody” here implies a succession of sound events that each have a certain parameter that is central. This is exemplified in the first three rehearsal letters of *Parametric Neutralizations Studies.*

Therefore, in cognitive-parametric music, the basic material is established not only by the number of parameters that define it, but also determined by the form in which the determination flows are settled down among the parameters. Consequently, the basic material of a parametric work is formed by a group of defined events around a set of parameters and the parametric rules that establish the relationships among those parameters. In its own conception, cognitive-parametric music is very abstract and reflexive (or recursive) because the use of parametric objects is a variable that is more inherent in the composition process and cannot be, by any means, neuter.

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4. Predicative-Aggregative parametric formalization

Relativity: Predicative-Aggregative definition of a relative abstract system

In this part of the book, I will discuss the formal logical skeleton of a parametric, particularly the dynamics that permit the formalization of relativistic models. Relativity, as I conceive it, must be part of this system. I have created this formalism for composing *Parametric Formalizations Studies*. As I have said before, it is a tool that can be used but does not have to be, unlike other musical currents founded in an isomorphism between certain extramusical theory and music, including scientism naturalistic models (like works by Grisey or Wuorinen), dialectical-political models (works by Spahlinger), or models derived from generative grammars. Everything within these models is part of our cultural heritage, so if the utility has been found, why not use it? However, utility and foundation are not the same. Personally, I am more formalist (Schoenberg, Adorno, Boulez, Nono, Feldman) than naturalist (Grisey, Guerrero, Varèse, Xenakis, Stockhausen). To me, music is primarily music; all that matters is the result, and not the approaches of its creation. Therefore, in order to create an interesting result, I am free to absorb everything I can experiment with and investigate, and I select and create music from what I find interesting.

I made this formalism for two reasons, the first because when I finished *Parametric Modulations Studies*, I had the intuition that in order to create new cognitive-parametric music, I would have to manage more complex concepts which would need a certain computability or at least a well-defined formalism. Therefore, a definition of certain algorithms is required. For this task, I did not use the computer (although I did in *Cognitive Dissonance)*; everything was made on paper and with a pencil. Once these algorithms were formalized, they greatly facilitated my work. The notes were always written first, and their formalization later. This activity of designing algorithms presented me with the possibility of making things from a different perspective, and what is relativity but seeing things from as many different angles as possible? The second reason was because I kept it in my pocket until later, when I extracted from this formalization all the consequences.

Predicative-Aggregative formalization[45] of a relative theory: A relative theory's components

Let's start by defining the nomenclature and the system used to formalize the theories. I will later define relative and absolute systems.
The Relativistic Theories' components are:

A set ***N*** of ***n*** parameters
A set ***L*** of subsets of ***N***
Another set of parameters (metaparameters) ***M*** (any parameter ***M*** can exist at the same time as a parameter of ***N***)

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[45] The following formalization is an example of modeling that was called the structural program (which has nothing to do with the structuralism of Lévi-Strauss). The reasons for using this formalism and not another fall outside the scope of this book. If someone wants to know more, I recommend reading chapter 6 of *Introduction to the Methodology of the Science* by Echeverria, or Sneed's book, *The logical Structure of Mathematical Physics*, Dordrecht, Hil. Reider, 1971 (2ª ed., 1979).

A metaparameter is a parameter that is used in the set of ***applications*** but that may not be within N. It can be a constant value or may vary depending on any other parameter, including those of N. The difference between a parameter and a metaparameter is only contextual, since a parametric translation can reverse the roles.

A set of reference systems $K = \{k, k', \dots, k^n\}$
A k reference system (which is defined by N parameters) whose center is defined on an event e_0.
A k' reference system (which is defined by N parameters) whose center is defined on an event e_0'.
And many other k^n reference systems defined in K (which is defined by N parameters) whose center is defined on an event e_0^n.

And many other reference systems as defined in K.

A set of *n-tuple* e events $E = \{e, e_1, \dots\}$ defined with respect to k.
A set of *n-tuple* of events or *l-tuple* $E' = \{e', e_1', \dots\}$ defined with respect to k'.
And many other sets of events as reference systems defined in K.

A set of sets of events defined as *x-tuple*, each to a certain system of reference k.

If objects e meet certain conditions, they can be vectors, but there may be objects of type e that are not vectors.

A position of each event belongs to e with regard to its axis of reference.
There is at least one event e belonging to each set E, which may be null.

An event $e' = \{x, y, \dots, n\}$ belonging to E' that defines the position of the event e concerning K'.

An event $e' = \{x', y', \dots, n'\}$ that defines the position of any event e with respect to K', according to applications.

And n events (as defined in K) $e^n = \{x', y', \ldots, n'\}$ that defines the position of any event e concerning K^n, depending on the applications A.

A set of applications A that associates and determines the variation in values of e to e' and/or any event of any axis of references to any other axis of reference, depending on the values of the parameters m .

$e=\{x, y, \ldots, l, \ldots, n\}$
$e'=\{x', y', \ldots, l', \ldots, n'\}$

$x \xrightarrow{A} x', y \xrightarrow{A} y', \ldots, l \xrightarrow{A} l',$

A simple example

As an introduction, let's first see how we can apply this formalism to a trivial problem:

We define a set of parameters N as a reference of one parameter system.
$N= \{x\}$
We define a reference systems K whose center is the event $e_0= \{0\}$.
We define a reference system K' whose center is the event (relative to K) $e_{0'}= \{5\}$.
And we define three events in reference axis K:
$e_1 = \{5\}$
$e_2 = \{10\}$
$e_3 = \{15\}$

To obtain the values of K with respect to K' is enough to define the following application belonging to A.
$e' = e - 5$
To obtain the values of K' with respect to K is enough to define the following application belonging to A.
$e = e' + 5$
$e_1'= 5-5 = \{0\}$
$e_2'= 10-5 = \{5\}$

e_3'= 15-5 = {10}

Definition of relativity

It is obvious that relative systems as well as absolute systems can be defined in this formalism: that is, so far, a tautology. We must define relative systems in such a way that they don’t become tautological. Thus, once we have said that something is relative, we can apply a procedure to verify that it truly is.

Relativity system

A system is relative when any event ***e*** reference ***K*** can be transformed into an event ***e'*** of ***k'***. And, by extension, if there are more than two reference axes (as is the case in the current work that I'm doing, *Cognitive Dissonance*, where the number of reference axes is very wide) ***A*** applications can be established in such a way that any event can be redefined around any other reference axis. A system is absolute when such a system of coordinates ***K*** with an established center exists so that it is not possible to choose another center and redefine all events ***e*** with respect to the new center. Conversely, ***a system is relative if applications passing from K to K' have reversed.***

$e \xrightarrow{A} e', e' \xrightarrow{A^{-1}} e'', e = e''$

A system is absolute only if there is a privileged coordinate system ***K***, where events cannot be defined through another reference axis. There can be only one center and the coordinates of an event with respect to another center cannot be defined, i.e., when it can be demonstrated that the application $\xrightarrow{A^{-1}}$ does not exist.
Thus, to demonstrate that a particular formalized theory with this predicative-aggregative model is relative is enough to prove that such an application exists.

Another simple example

We define a set of parameters ***N*** as a system of three parameters:

N = {x, y, z}

where ***x*** is the wealth of a given person, ***y*** is the poverty threshold of a society. and ***z*** represents the economic position of a person in a society.
We define a coordinate axis ***k*** whose center is the threshold of poverty in a given society as $K_0 = \{4, y, z\}$.
We define a coordinate axis ***k'*** whose center is the threshold of poverty of another society as $K'_0 = \{10, y, z\}$.
Note that when defining a coordinate system, we can define a center with respect to a single parameter, as in this case (note the lettering of the parameters) all of the parameters can be defined (as in the case of the special relativity theory).
When we define an individual ***i*** whose wealth is 20, we can enunciate two things:

1. A person may be rich or poor without changing the wealth relative to a society.
2. That the wealth of a person with respect to the society in which he lives determines his position in a given medium.

So, we can make an application that tells us, with a number of fixed wealth, what place he would take in different societies:
z = x - and
Then z = x - y = 20-4 = 16
z '= x' - and = 20-10 = 10

We can also calculate the wealth that a person should have to occupy a certain place in an specific society:
x = z+y
If we define ***z*** as 20, then the person ***i***
x = 20 + 4 = 24
x' = 20 + 10 = 30

In each of these two cases, there is a central parameter with respect to the other two. However, the central parameter can be changed without affecting the function that relates them: this is what I mean by relativity. In other words, when we look at this matter from the parameter that we want to act as central, the function is equivalent.

In an *absolute system* only one parameter as central can be considered. Thus, if we consider the problem from each of the parameters that act as central, there is not an equivalence between the different functions that connect them.

However, we have used the concept of centrality in three different ways, which indicate three types of centralities:

1. A reference ***k*** is central and privileged over others, so in such an absolute system defined by this predicative-aggregative system. there is an application of ***k*** to ***k´*** and the reverse is impossible.
2. Each coordinate axis ***k*** has a set of parameter values that defines its center.
3. Within a system of coordinates ***k*** there is a central parameter that determines the other. There may be two cases in which this parameter is privileged and may not be changed, or this parameter can be changed to be equivalent to both operations. In the second case, we can define a central parameter change to another through the ***parametric translation*** process. This is what happens in a system in movement: a particular change occurs when a parameter that was central and determinant is replaced by another. A good example could be the development of human societies, where the determinant parameter continues to change over time.

We define this even more precisely: a ***system is absolute*** only if there are centers in the three ways mentioned above, or if there is not an operation, function, or application that allows for a change or rotation of those centers.

Definition of relativization

An absolute system can be converted into a relative one if we find the way that a privileged center stops acting as such. This process of converting an absolute system into a relative one is called relativization.

An example of this is the step forward from the belief that the Earth was the center of the Universe, to the idea that the Sun was the center of the Universe, as well as to the idea that neither the Sun nor our Galaxy are the actual center. Any absolute system can be relativized by the introduction of new parameters. To show that something is relative, one must demonstrate that it is possible to introduce an element that halts the old privileged center from acting as central any longer.

We have seen at least two trivial examples so far, but let's see what happens when the reference axes are not fixed among themselves, but instead move with respect to others around any other parameter or metaparameter. In Einstein's special relativity (not to be confused with general relativity), two reference axes move at a different speed from one another. In *Parametric Formalizations Studies*, this refers to the phase between iteration, which is the displacement of both reference axes. In *Parametric Formalizations Studies.* the phase between iterations constitutes the displacement of both reference axes.

Another example: the Doppler effect

We will now see examples of reference systems that move with respect to another through some other parameter. It is in these cases that this perspective of formalism starts to make sense.

The Doppler effect[46] describes the phenomenon that can be seen when an object (the focus) at a certain speed passes in front of another (the observer). When one object (the focus) is approaching, the sound has a higher frequency than when the object moves away: the intersection is a turning point. To simplify this model, we assume that the observer and the focus are in a space of a single dimension (a line) at a quite inert ideal medium. We also assume that the observer does not move and is in the zero (0) position of such straight line.

$N = \{speed, position, frequency\}$

"Speed" is how fast the sound focus moves, "position" is the straight position of the focus in the line, and "frequency" is the perceived frequency of the sound produced by the focus. It is clear that the frequency of the sound produced by the focus remains the same, but changes for the observer.

$M = (C)$
"C" is the speed of propagation of the waves in the air.

There are two reference axes: the focus and the observer (a person):

$K_{focus}=\{v_f, p_f, f_f\}$
$K_{observer}=\{v_o, P_{fo}, f_o\}$

The speed of the observer, in our case, is zero and remains stationary.

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[46] For a more detailed read, see pages 537–541 of the book Sears, Zemansky, Young, *Physics*. E.

Finally, we have the application that gives us the frequency perceived as a function of three cases:

1. If $p_f > p_o$ or the focus is approaching the observer, then:

$$f_o = f_f \frac{c}{c + v_f}$$

2. If $p_f = p_o$ or when the focus and the observer are exactly at the same point, then:

$$f_o = f_f$$

3. If $p_f < p_{or}$ or the focus moves away from the observer, then:

$$f_o = f_f \frac{c}{c - v_f}$$

The frequency perceived by the observer is therefore relative to its position, with respect to the focus and the speed at which the focus moves.

If two objects move at the same speed together, one over the other, they have no sensation of movement; the perpetual variation at a constant speed implies the loss of the sensation of movement. This is essential to understanding *Parametric Formalizations Studies.*

A concrete example: the Theory of Special Relativity[47]

We have[48] a set of ***N*** parameters, which are the position of an object in a three-dimensional space at a time ***t***, i.e., four parameters or four dimensions.
A set of parameters ***M*** consists of two parameters ***m*** that are the speed movement of ***k*** with respect to ***k´*** and the speed of light.

A reference system ***k*** (three-dimensional coordinate axis over time).
A reference system ***k´***(three-dimensional coordinate axis over time) that moves with respect to ***k*** at a given speed ***v*** (metaparameter).
A position of ***e*** with respect to ***K***.
A position of ***e´*** with respect to ***K´***.

The set of applications that determine the variation of the values of ***e*** and ***e´*** depending on the parameters ***M*** is the Lorentz formula:

$\boldsymbol{N} = \{x, y, z, t\}$
$\boldsymbol{L} = \{x, t\}$
$\boldsymbol{M} = \{c, v\}$

$$A=\{x \xrightarrow{a(c,v,t)} x', t \xrightarrow{b(c,v,x)} t'\}$$

$$x' = \frac{(c-v)t}{\sqrt{1-\frac{v^2}{c^2}}}$$

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[47] I hope that physicists forgive me for this. I have said, and will say again, that I do not intend to say anything about the theory of relativity or anything about time or space in terms of physical phenomena. I have described this here as only an example. Those who know how to read between the lines might find out certain things later in this book.

[48] In what follows, I am going to paraphrase the paragraphs 4 to 17 from Einstein´s book, *The Theory of Special and General Relativity.*

$$t' = \frac{(1-\frac{v}{c})t}{\sqrt{1-\frac{v^{2}}{c^{2}}}}$$

An example

Let’s imagine a person traveling on a train and another person watching the train from a pathway through which the train is passing by. The train travels at a speed ***v***. Imagine that an ***e*** event occurs with respect to the person on the train (axis of reference ***K***) ***e*** = {*x, y, z, t*}.

The theory of special relativity tells us that the event ***e*** is not simultaneous to the two reference axes and is, therefore, relative to the reference axes with respect to which we are located.

Thus, the theory of special relativity gives us an application that allows us to define the same event ***e*** from the two different reference systems, which are differentiated by the speed with which one moves with respect to the other one.

And the event ***e*** referred to the person of the platform would be (reference axis ***K´****)* ***e'****= {x´, y, z, t´}.*

The formalization of the theory of special relativity allows us, given two reference axes moving with respect to the other, to specify the coordinates of an event ***e*** for each of them.

For a formalization example of a work through this system, read chapter 6 under the title *Predicative-Aggregative formalization of the work*.

Definition of non-relativity to prevent a tautological definition

Now, the question that arises: Can the formalization of the relativity theory also represent theories that are absolute in nature? The basic difference between an absolute and a relativistic theory is that the latter does not have an absolute center from which fixed determination flows can be established.

Definition of parametric translation

A parametric translation is the process by which, in a system, there is a change in the parameter that is central and determines the flows. This process can be regulated at the same time by another parameter or metaparameter that occupies a privileged place in the hierarchy of parameters, but just for a while because it can effectively move to a lower place in a moment’s notice.

Determination flow

The definition of a determination flow is the process by which a central parameter determines the value of others.

Formalization of signification space

We can now formalize the signification space as a function or application that assigns a meaning value to the objective difference between two values of a parameter ($\boldsymbol{e}, \boldsymbol{e}'$) that represents the signification of this difference.

For example, we can describe the spectra of different colors as significant or insignificant based on the number of different words that a language has to define colors. The same objective difference can have a subjective and maening value, depending on the importance of this difference to a subject or a collective.

For example, we can define $E=\{fr\}$ where fr is the frequency of a color:

We have $\boldsymbol{e} = fr$ and we have $\boldsymbol{e'} = fr'$
I.e., two frequencies or two colors.

We define ***nw*** as the number of words that are used to enumerate the colors in such a difference in a given language ***L***.
And the application that allows us to set the signification space for a specific range of frequencies in a given language ***L*** and a given environment ***E*** is defined as:

$$A(\boldsymbol{E}, \boldsymbol{L})=nw/(fr-fr')$$

This metric of the signification space will assign a relative significance to an objective difference in frequencies, but in this case, which is operationally well defined, it depends on the number of words used in a language *L* to enumerate the colors in that range. If the differentiation between colors has an important function for survival, the significance of the difference field value will be high since many words were created to enumerate the degrees of difference. The operation by means of which this application gets its value can be defined mathematically, logically, or operationally using a well-defined metric that may require some kind of subjective interpretation. As we have seen, the significance is always subjective, in the sense that meaning is not a property of things that mean, but rather is given from the outside: it is semiotical.
In a colloquial way, we may summarize that the greater the functionality of survival by differentiating the colors, the greater the number of words to define colors. However, if we want to word this a bit more accurately, we should say that the number of words assigned to a frequency difference in light depends on the importance of this difference to the survival of a certain collective.
For that reason, the application defines the importance of a difference within a field to a third entity. Thus, a fact is significant when the difference between two ***e*** means something to another third entity. Now, with a little logical precision, we can say that the smaller the distance required between two ***e*** to achieve an implication, the greater the signification space.

We can thus define language as an application of the signification space that assigns a value to a difference.
But the importance of a difference can change over time, which is where this concept takes on additional importance. For example, 10.000 km had immense significance in the year 1000, but it has a smaller meaning in the year 2000; although the objective difference has not changed, i.e., the signification can change (in this case on the basis of time), it is the signification space that assigns importance to a difference depending on another parameter. This is the foundation of cognitive-parametric music, where the significance load of a difference (e.g., an interval) depends on a process that occurs in another parameter.

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5. Analysis of *Parametric Neutralizations Studies*

Introduction

In this work, as in previous ones, I seek a formal articulation that allows several listenings of the work (i.e., which parameter determines which one to be central), looking for a type of music that has several readings based on the position of the listener in regard to the work.

I now part from my reflections on how to approach music with a critical social function, moving beyond the so-called dialectics between society and its denial. The Avant-garde used ugliness as a way of creating something new while criticizing society itself at the same time. But the system has learned how to neutralize the power of the new and the critic's objectification of it as a product, causing ugliness to lose its critical power in the end. It is a discourse well-inserted into modernity, self-critical and aware of the problems of the malicious dialectics.

The power of such modernity is not based on the material I work with since there is no longer a material with a critical power and that is not absorbable by society itself. Instead, I create new concepts to analyze reality in a different way, for which it would be necessary that the determinant of what occurs in the listening was not what the composer wants. The composer, more than simply giving a message, facilitates a structure around which things not foreseen by him can happen. The composer creates a medium for the listener so he can decode reality differently. The critical power is the possibility of generating new structures of intelligibility. To do so, the concept of parameter (as properties of sound objects) is treated as another musical material in order to expand the materials available by the composer. The introduction of the parameter concept as musical material has the advantage of creating new materials, without entering the typical dialectics, that create abstract materials that, because they are hardly detectable by listening, allow cognitive tensions and ambiguities and facilitate multiple decoding processes of the sound object's significance.

It is about continuing to deny the concept of goods of consumption or mere entertainment in the work of art. It is about launching processes that have many possible readings, as if the composer gave a broadcast with a lot of channels and the public could choose which to focus on in every moment of their listening, changing from one channel to another at their own discretion. Ultimately, the listening public decodes the signals within the chosen channels. The critical political power has more to do with searching for a new intelligibility of reality than with specific content issues, allowing us to deconstruct our perceptions of what we think we are and what we are, and therefore overcome the limits regarding what we think is possible and real.

To do so, I must part from a reflection on the significance of sound entities. To neutralize a parameter means several different things. In general, to say that a parameter is neutralized means that it holds no importance in the sound discourse, i.e, when it is meaningless. To neutralize a parameter means to stop it from having the significance that it held in the previous passage.

There are two basic strategies for neutralizing a parameter: immobilizing it or canceling the significance of its movement (in reference to its change or difference). You can neutralize a parameter by making the difference between the sound objects cease to be significant. For example, Scelsi neutralizes pitches by statism, while Ligeti neutralizes pitches through the loss of their individuality by integrating them into sound masses.

Neutralization is a process whereby the meaning, which is a difference of the value of a parameter in a given time, is lost in the next moment. The process describes how an objective physical fact holds certain subjective importance depending on the context, and how this context is mutable and can be manipulated to control the significance of a difference. If we assume, for example, that a difference has a relative meaning based on something important, neutralizing a parameter is to achieve such a difference in order to completely miss its importance. Thus, the concept of neutralization rests on the relativity of the significance of things. The *signification space* is a function that assigns a certain importance, i.e., a particular significance to a difference, in a particular parameter according to another parameter or entity. Therefore, neutralizing consists of making the signification space of the difference of a parameter lose it value. That is why there is a parameter in each subsection in the first part of the work whose significance depends on another (metaparameter), and it is this central metaparameter that determines what happens in other parameters in the section. But the next section changes which parameter is central (parametric modulation) and reaches a sort of climax in which there is no longer any central parameter.

Neutralization also implies the loss of consciousness that a parameter exists, a process that can be achieved in several ways. In order to achieve that, I propose creating a structure based on a gestural cognitive model that differentiates between a determinant parameter and a determined one in each section whose roles are changing throughout the work by a rotating process. The neutralizations facilitate the creation of determination flows among the parameters that allow cognition to associate the relevance of one parameter in function of another one. If this were not so, it would cause the determining flows to move arbitrarily The existence of a metaparameter provides directionality in the determination flow. Of course, the existence of this directionality is pure illusion and is in fact modified in each section of the work, inversing the determination flows.

The idea is about playing with the concepts of intelligibility and cognibility as tension generators. The tension of the speech does not depend on the materials but on the possibility (or lack thereof) that the listener generates certain cognition or intelligibility from what he hears. In my previous works, only one parameter was neutralized. This composition is the first time that I try to extend the concept of parametric neutralization to all parameters, wherein there is a different neutralized parameter in every moment of the work. For this purpose, parameters are neutralized according to the significance of others through certain cognitive strategies.

Only four parameters are considered in this work: pitch, timbre, dynamics, and time. In each section, a parameter can: (1) become neutralized, (2) become the central determiner (metaparameter), or (3) be determined by the metaparameter (active parameter). These functions rotate according to the formal structure of the work. The formal structure is cognitive-parametric in the sense that it defines the contrasts not by materials, but by the way in which the function of each parameter is defined in every moment.

During the first section of the work, each part has two neutralized parameters and a central parameter that determines the signification space of the active parameter. Each section has a parameter that is never neutralized and determines the significance or neutralization of the others. Each section is subdivided into subsections defined by a parameter that is not neutralized (active). By moving from one section to another, the metaparameter in changed, producing a parametric modulation in this section. At the beginning of each consecutive part, the active parameter changes. The active parameter is thus determined by the metaparameter to establish the determination flow, while the other ones remain neutralized.

A *parametric modulation* is like a modulation in tonal music that passes from one tone to another. In a parametric modulation, the metaparameter is changed. Because the central parameter is constantly changing, the overall result of the work is that there is no longer a dominating speech or sound object cognition parameter. This procedure becomes increasingly complex with so many unneutralized parameters and ambiguous determinations that it is ultimately the listener who determines which one is the central parameter. This inevitable establishment of the determination flows by the listener is what I refer to as the liberation of listening.

The work’s tendency to demonstrate a greater parametric ambiguity has an equivalent in the tonal music, as seen in the differences between music in which tonal functions are clearly defined, and music that floats along in a constant change of tones without establishing a strong tonality. Thus, the work is based on a very strong settlement of the determinations of a parameter over others, in order to gradually make the music more ambiguous. The sense of this evolution is that the growing ambiguity allows listeners to individually establish the determination flows.

Gestural patterns

In order to provide greater coherence to the work, I thought that it would be necessary to create a structure in which every section would have something in common. It is obvious that such common element could not be related to any parameter in particular to avoid interfering with the main process of the work, so I decided that the best option would be to create a sort of gestural Pattern A s a cognitive model that would last for the duration of one subsection and be repeated with certain modifications throughout the entire work.

This gestural pattern serves as a cognitive model and stipulates the how listening will establish the determination flows through the correlation of various parameters. Furthermore, this cognitive model establishes which relationships between materials are easier to memorize. The memorization of certain correlations helps to create abstractions that are then applied to the rest of the elements. The gestural patterns work to initially establish the determination flows. The cognitive model on which the patterns are based will be responsible for this establishment; upon listening, a certain parameter pattern will be considered the determiner of the others at that particular moment in time.

This gesture pattern is composed of three elements that can be represented graphically by a vertical bar, a horizontal bar, and a regulator that has two parts. This pattern is very ambiguous. As the work unfolds, the listener will gradually experience greater freedom in the application of the pattern on each subsection.

In the first three subsections, I use a cognitive strategy to keep the gesture pattern the same, which facilitates memorization more easily while keeping the pattern recognizable through other cognitive processes. A basic memorization through repetition facilitates the recognition of certain regularities. Then, depending on how strong this memorization is, the effectiveness of the pattern recognition process determines the establishment of determination flows in the ambiguous fragments. Thus, listening will be relative to each person according to their mechanisms of memorization and cognition of gestural patterns.

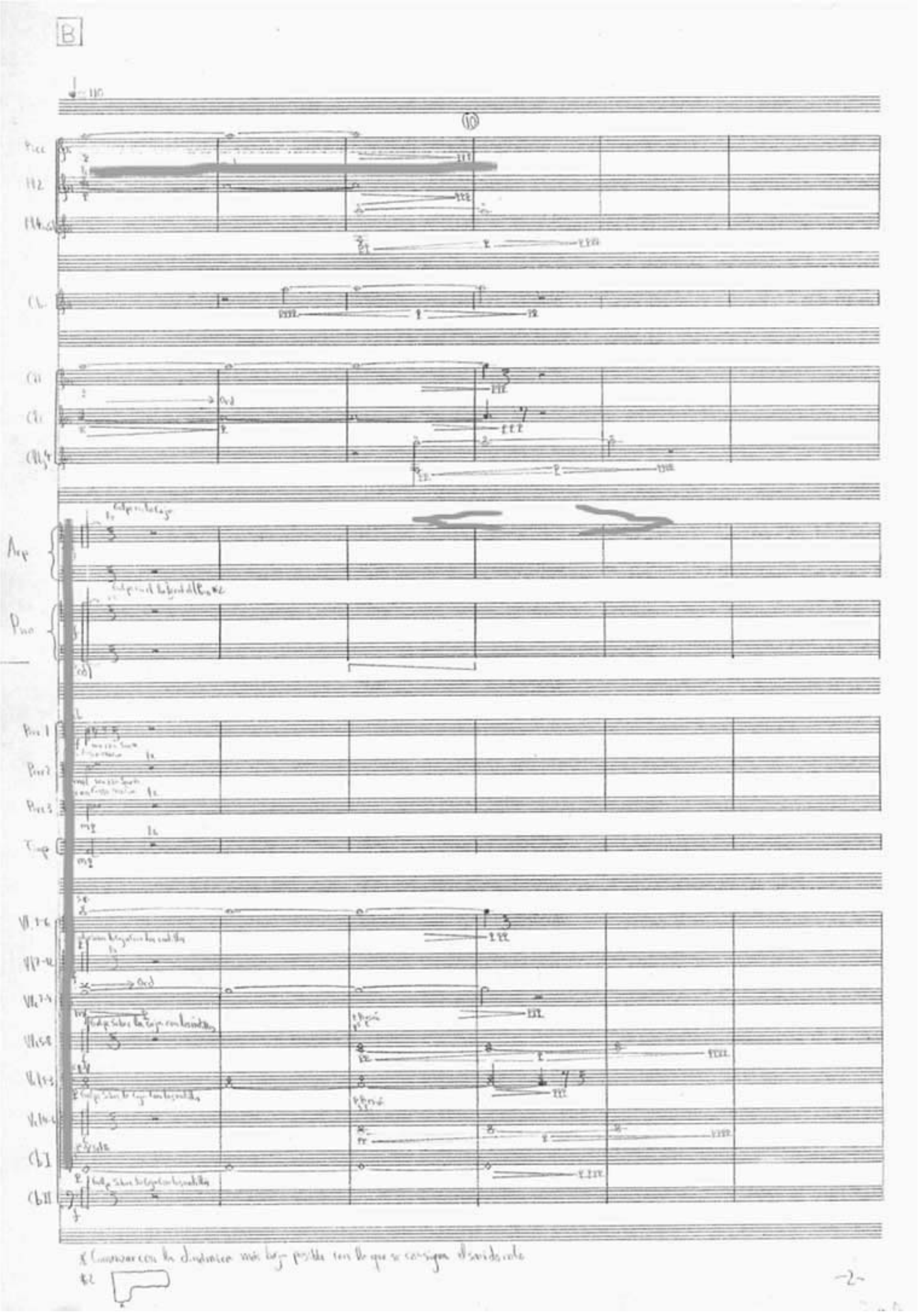
Once it is established, the manner in which the metaparameter determines the other active parameter through the gestural pattern settles the abstraction of the overall process, which can then be memorized or forgotten depending on each individual. In this way, the gesture pattern is repeated always exactly three times. This favors two functions: that the gestural pattern was engraved in memory, recognized as such in spite of the successive variations; and that the first three subsection are utilized as a settling fact (see the analysis of *End Game*). This is a way to establish the work's own principle of order or intelligibility. The gestural pattern is the cognitive approach used to establish determination flows between parameters. In the works that followed, I found other parametric forms to establish determination flows, without using something external.

The listener is considered as a kind of cognitive system based on a series of algorithms and a memory, both of which can be different for each individual. The sound flow is the entrance into this cognitive system, which, according to the algorithms of pattern recognition and their memorization capabilities, will produce a certain interpretation and specific pattern recognition.

Gestural patterns allow for certain listening conditioning while the listening takes place. They endorse the association of an occurrence of any particular event to another (as in *End Game*) and allow us to understand correlations between parameters. And later, when the sound flows do not follow the rules that were initially provided to establish the conditioning of listening, is when cognitive dissonances occur.

The concept of listening liberation and multiple listenings are based on the idea that each person has a different memory and different pattern recognition algorithms, which is what generates a different interpretation of the sound flow in each individual.

Unlike traditional algorithmic music, the considered algorithms in cognitive-parametric music are not only used to create music but are also used by the cognitive system that directs the music.


B
♩= 110
10
Picc
Fl2
Cl.
Arp
Pno
Timp
Cb I
Cb II
* Comenzar con la dinámica más baja posible con la que se consiga el sonido
-2-

The gestural pattern of rehearsal letter B (in color at http://busevin.art).

On the figure above we can see, for example, how the first gesture pattern is applied to subsection B. In this case, dynamics, as a metaparameter, determine the timbre as an active parameter: when the dynamic is higher, we hear noisier timbres. In this way, we correlate these parameters with this relationship; for example, a vertical bar is applied to the first stroke which is almost hammered to produce noise (such as hits on the string resonance boxes). The vertical line is represented by sustained sounds in *A* at low dynamic, which start from the beginning of the section and remain until they fade out. Finally, we have the third element that represents sounds, which always indicates a crescendo and a diminuendo for sinusoidal timbres.

Analysis

The analysis that follows is not intended to be more than a rough outline. It describes the main structure of the work and shows a few small details in order to explain the basic procedures that I used. It does not pretend to analyze the work in detail, but rather to demonstrate its most general lines. This analysis does not exhaust all the constructive details of the work, nor provide all the necessary explanations about all the work events.

First part of the work

The first part of the work (rehearsal letters A–I) has a singular formal structure in which, in turn, the same functions are distributed on the parameters. Some parameters are completely neutralized, another acts as the central parameter that determines how the parameter that is not neutralized follows the gestural pattern (metaparameter), while yet another parameter that is not neutralized has a significance value that is conditioned by the central one (active). In each subsection, the neutralized and not neutralized parameters are different but the parameter that acts as metaparameter is always the same. In the first part of each section of the work (which is subdivided into three subsections), there is a central parameter that determines the significance of other parameters, i.e., which parameter is neutralized and which one is not. In each one of the subsections in which the metaparameter (notated as >) is central, there is only one parameter active (notated as +).

The ***first section,*** bars 1–21, is subdivided into three subsections. This first section corresponds to the settling fact.

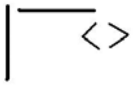
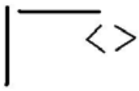
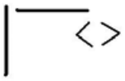
Dynamics represent the parameter that determines the others. Each of the three subsections is a gesture that corresponds to a decrescendo. In the first subsection, the pitches change from a cluster of 24 notes in quarter tone to a single note, a process associated with the dynamics, while the timbres and rhythms remain unchanged. In the second subsection, the pitches are neutralized, meaning they have not already changed around rehearsal letter A, which is the last note left in the previous section and is making now a symmetry center from the disappearance of the notes in the cluster of 24 quarter tones. A new diminuendo, associated this time with timbre, begins, so that we have only noisy timbres at the beginning that eventually give way to sinusoidal ones. The third subsection's higher dynamics correspond to a complex overlapping of rhythmic layers, while the lower dynamics relate to a very simple rhythmic structure in which the other two parameters (pitch and timbre) are neutralized, albeit not as much as in the first two subsections: we begin to anticipate a gradual easing of initial determinism.

In the first section, the dynamics are the determiner of change to the other parameters. In other words, the parameter that is always changing in the three subsections is the central parameter in this section.

This process is meant to *induce the listener* in such a way that the variation of any of the other three parameters is associated (correlated or conditioned) with variation in the dynamics.

This conditioning listening process begins with the correlation between a change in the number of notes with the decrease of the dynamics, then with timbre, and subsequently between the rhythmic complexity and the decrease in dynamics. So it is through this long settling fact that a principle of order is established, conditioning listening in regard to the cognition of the significance of changed parameters as well as the dynamics. The significance of the latter is associated with a process of change in the other parameters.

The settling fact consists of a particular principle of intelligibility and the significance of sound objects through a cognitive strategy (based on a gestural cognitive model). The settling fact is based on the idea that everything is relative and that there is not a principle of order for universal sound speech. The settling fact is a set of sound objects that uses perceptive techniques or cognitive models to establish (make possible) the principle of intelligibility of the work.

	First subsection A rehearsal letter	Second subsection B rehearsal letter	Third subsection C rehearsal letter
dynamics	>	>	>
pitch	+	-	-
timbre	-	+	-
tempo	-	-	+
gestural patterns			

Parametric array at the beginning of the work.

I use chords with symmetrical distances between notes (i.e., tritones, diminishes sevenths, major seconds increased by a quarter tone, etc.) to disassemble the cluster chord in the first subsection. Since the goal is for all the chords used during the disassembly of the cluster to be formed by symmetrical intervals, it was necessary to use microtones. The creation of asymmetrical structures would have generated harmonic processes with a meaning load that would have distorted the procedure.

A basic cognitive rule that is widely used in this work is that *the asymmetry favors the recognition of patterns*. When we want to reinforce the recognition of certain structures associated with a parameter, we use asymmetric structures. When we want to avoid the recognition of a particular Pattern A ssociated with a parameter, we use symmetrical structures. In cognitive-parametric music, the use or avoidance of symmetrical or asymmetrical structures facilitate certain recognitions of a determination process. Therefore, if we want a parameter that appears to be determined by another, the one that determines will be asymmetric, while the other is symmetric. Tonal music makes this easier because the pattern recognition to decode parameters uses more asymmetries than symmetries in relation to how intervals are structured within scales. Therefore, one of the techniques used for listening conditioning is the establishment of determination flows based on the use of symmetrical distributions in one parameter and asymmetrical distributions in the others.

During the first section, parameters are neutralized or not depending on the process of another parameter. The dynamics is a metaparameter that defines, determines, and conditions the cognition of other parameters. Otherwise, determination flows processes with the same parameters over others would be too arbitrary. At the beginning of the work, it is necessary that a particular parameter determines others. This process becomes dirtier as the pieces goes on; once the moment of maximum fouling is reached and a tautological moment occurs, the liberation of listening begins.

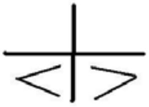
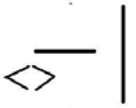
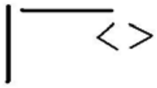
There is a directionality in the formal structure in the sense that the parameters are initially determined in a very clear manner to others to establish a principle of cognition. Subsequently, this process becomes more diffuse through the expansion of the number of parameters that are determined, by the increasing number of parameters being determined, and through the inversion of determination flows that also become less precise. Thus, by increasing complexity, the cognition process becomes more difficult, allowing each listener to choose a personal strategy for intelligibility and produce a listening experience that differentiates from that of any other listener. This process ends at bar 90.

The determination of time as a parameter is produced through the superimposition of several rhythmic structures that dissolves through a process in which each new bar increasingly gives the pulse to a simpler rhythmic structure so that a simpler pulse is increasingly highlighted in order to obtains the focus of the listener. Each bar introduces a new rhythmic logic that increases or decreases the rhythmic complexity, depending on the case.

The work is based on the concept of gesture and features a kind of gestural pattern that repeats itself with certain permutations. This pattern seeks to establish a repeating pattern that serves to provide an element of similarity between all sections, thus allowing a certain principle of organization and order.

The ***second section***, bars 22–48 or rehearsal letters D–F, is subdivided into three subsections.

During this section, the dynamics cease to be the central parameter and pitch takes its place. For the first time, the gestural pattern is altered, which leads to the performance of the first parametric translation without any transition (see my analysis of *Parametric Modulations Studies* for more detail).

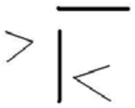
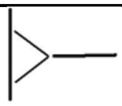
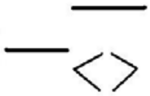
	First subsection rehearsal letter D	Second subsection rehearsal letter E	Third subsection rehearsal letter F (inversion of A)
dynamics	-	-	+
pitch	>	>	>
timbre	+	-	-
tempo	-	+	-
gesture pattern			

The first inversion of the flow determination occurs in this section. In the first section, the dynamics act as the central parameter, while pitch acts as such in the second section. (This would have happened in any case, regardless of the metaparameters that were elected in each of the sections). In this way, dynamics determine the pitches in the first subsection of the first section, whereas the pitch determines the dynamics in the third subsection of the second section. Therefore, the gestural pattern chosen for this last section is the same as for the first subsection, which allows the first two sections to form a closed unit. I refer to this subsection as a parametric cadential closure since there is a certain parallel between the first subsection of the first part and the third subsection of the second section.

In a general fashion, the correlation between pitches and other parameters in this section is achieved through an increase in the number of pitches around A. Consequently, in the first subsection, low dynamics involve a single pitch while higher dynamics involve several pitches. Although this process is ambiguous, a slightly weaker correlation exists in the second section, where the rhythmic complexity is associated with a greater number of pitches and higher dynamic degrees are associated with a greater number of notes.

The ***third section***, bars 49–69 or rehearsal letters G–L, is subdivided into three subsections.

The tempo is not understood here as a duration but as a space that varies between rhythmic simplicity and complexity. Such complexity is achieved through the superposition of rhythmic layers.

	First subsection rehearsal letter G	Second subsection rehearsal letter H	third subsection rehearsal letter I
dynamics	-	-	+
pitches	-	+	-
timbre	+	-	-
tempo	>	>	>
gesture pattern			

In this section, the main parameter is time and, in the same manner as the second section, the first determined parameter is timbre and the last one dynamics. In this way, the second and third sections form a symmetric block. In the central part of this symmetrical block, there is a double mirror in which an inversion of the determination flow takes place.

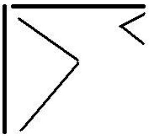
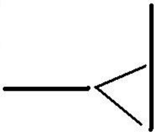
Second section	Central parameter	pitch	pitch	pitch
	Determined parameter	timbre	tempo	dynamics
Third section	Central parameter	tempo	tempo	tempo
	Determined parameter	timbre	pitch	dynamics

In the four sections of the first part, the dynamics are always used as a cadenza since it was the first musical element to work as a metaparameter. This strategy of merging the second and third sections in a central block to create a double symmetry aims to differentiate the first and last block, thus allowing the last block to have a cadential flavor that solves cognitive tensions.

We have seen how a parametric cadential process can be built that replaces the typical cadential processes in tonal music or the processes' densities in serial and postserial music. This is the true meaning of a parametric formal structure: the sound elements are organized in such a way to allow for a true parametric cadential speech that is achieved through the conditioning and deconditioning of the determination flows.

The ***fourth section***, bars 70–106 or rehearsal letters J–L, is subdivided into three subsections.

The second subsection's gestural pattern is the same as the gestural pattern of the second subsection of the previous section, but inverted. This inversion, coupled with fact that an inversion of patterns occurs in each central subsection, is used again as a way of establishing a mirror that indicates a certain unity between the third and fourth sections of the first part, allowing a certain cadenciation that makes it possible to avoid the gestural patterns in subsection L that anticipate the second part.

	First subsection rehearsal letter J	Second subsection rehearsal letter K	Third subsection rehearsal letter L
dynamics	-	-	+
heights	+	-	-
timbre	>	>	>
tempo	-	+	-
gesture pattern			Re-use of materials already appeardd in preparation for the second part

Second part of the work

The second part of the work begins in bar 107, at rehearsal letter M. It is divided into two sections, each of which is divided again into two subsections.

In the first two subsections, there is only one neutralized parameter and there is no longer a central parameter. In subsection M, durations are relatively neutralized, whereas pitches are relatively neutralized in the N subsection.

In subsections O and P, which is the final parametric climax, there is no longer any neutralized parameter.

	M	N	O	P
dynamics	+	+	+	+
pitch	+	-	+	+
timbre	+	+	+	+
tempo	-	+	+	+

After the cycle of the first part, wherein each section contains a central parameter, listeners can choose determination flows freely. In addition, the composer can relativize the neutralization of the parameters with greater flexibility, a process that was already anticipated in the last subsections of the first part of the work.

Structure of the work

First part				Second part	
2 first sections		3rd and 4th section		Only a neutralized parameter	All active parameters
Section 1	Section 2	Section 3	Section 4	Section 5	Section 6
Subsections ABC	Subsections DEF	Subsections GHI	Subsections JKL	Subsections MN	Subsections OP

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6. Analysis of parametric modulations studies

Introduction

This work aims to examine the possibilities of parametric modulations in a more fragmented way than in the previous chapter, beginning with the analysis and abstraction of the modulation in tonal music.

From the classical perspective, modulation is the process through which one tonality moves to another. This requires a certain strategy, such as the use of a common chord to both keys. From a more abstract analytical and musical perspective, a modulation is the set of techniques used to make transitions between musical fragments where each fragment is ordered around a set of hierarchized elements. One element of this set is given as central. Modulation is the change of that central element, so that the hierarchy of the elements that form part of the organization changes. In the case of tonal modulation, the fragments to be modulated are each organized around a scale with a tonal center. Through the modulation, one fragment is passed to another in which the organizing center of the scale changes. This usually requires a common element in both fragments, which is frequently the dominant chord of the new tonality. In tonal music, the central parameter that regulates the speech sound is the frequency, so all used frequencies are ordered from the one that is set as central; in this environment, modulating means to change the pitch of the event that is being used to order the others.

In this manner, abstracting in a modulation consists of four elements:

1. A set of items ordered (the pitches in tonal music or the series of parameters in cognitive-parametric music).
2. Two subsets or scales of the previous set (i.e., two scales derived from all pitches, or subscales of parameters).
3. Defining a central element in each of these subsets; this is the tonic of the scales in the case of tonal music, and the parameter which determines the others in cognitive-parametric music.
4. Finally, a common element is used to pass from one to another and that may not exist (i.e., a chord common to both keys, or parametric inter-definitions through the correlation of their respective signification space).

The concept of modulation has been applied to more than just pitches in music. Stockhausen, in reference to his work *Telemusik*, speaks about modulation to define the transition between discrete passages, each one in a different style:

> I tried [referring to *Telemusik*] rather, to relate very closely these phenomena apparently so heterogeneous [refers to recordings used in the work of various music styles Balinese music, Buddhist chant or music] through various modulation processes. The old concept of modulation of changing from one key to another tonality, is applied here to the styles. A musical event module to another, or even one event to another [here, modulation refers to modulation concept in telecommunications]. [49]

Carter also used a system of metric modulations. In fact, he it was the first composer who abstracted the concept of modulation and applied it to a context different from pitches:

> This change of metric [referring to mun.1 string quartet] is an example of Carter's `metric modulation' whereby a new meter is introduced as a translation of an old one, opening up the possibilities of pulses which would not have easily been available before, just a harmonic modulation changes the temporary tonic and thereby the pitch repertory. (Griffiths, *Modern Music and After,* p. 56)

One of the things I try to do in this work is to create modulations in the most abstract form possible; therefore, instead of using elements organized around a parameter – either pitches or other aspects – I generate scales of hierarchically organized parameters, so that each parameter is settled as central and determines the other parameters. By parameter scale, I simply mean a set of parameters, i.e. {frequencies, durations, timbres, and dynamics}. In addition, I understand tonality as a particular set of notes.

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[49] This is quoted from an interview published in the magazine *Christ und welt* in June 1968, in which he speaks about aesthetics considerations of his work *Telemusik*. This was extracted from the publication, *Electroacustical Music Analytical Perspectives* by Thomas Litaca (Greenwood, 2002, p. 94) in the analysis made by Jerome Kohl about this work.

A scale parameter is a subset of parameters from a total set of parameters. The choice of the number of parameters that is part of this set is somewhat arbitrary. Nowhere is the number of parameters that must be part of these scales or be taken into account specified or suggested. Since 1 octave is divided into 12 semitones and the choice of scales of 7 elements is arbitrary, it is equally possible to divide the scale into 24 quarter tones and use scales of 14 elements. The definition of the parameters taken into account is what I call the parameterization of the work and, in this case, I use the classical Xenakis formalization described in *Formalized Music*. It is certainly possible to make cognitive-parametric music using more parameters, and even some of the parameters considered here can be divided into several additional ones. You can also increase the number of parameters to include space or the sound spectrum. I insist that the recourse to an existing accepted parameterization that is well formalized is for pedagogical and simplification reasons, similar to how Schoenberg turned to neoclassical forms in his first twelve-tone works. There is a kind of unwritten rule that is established when introducing a new concept: you have to rely on something old to pedagogically facilitate understanding. To put it simply, the work is a constant parametric modulation between parameter scales; in other words, instead of using hierarchies of a given parameter, I use hierarchies of parameters. This is an extension of integral serialism because there are no longer parameter scales in the latter part of the work: only a parameter scale (parametric row) subjected to a serial method (parametric serialism). The parameter to be modulated thus ceases to exist; instead of modulating a parameter, we modulate between parameter hierarchies.

Here, parametric modulation consists on two sets of parameters; in each set, there is a parameter that is the most important and determines the musical speech and the rest of the parameters. We now have two hierarchies of parameters and a common element for modulation. One way to begin the work is by using two “scales” formed by two parameters, each with a common parameter. They begin with the obvious, i.e., dynamic and pitch for the first fragment. Tonal scales are replaced by a scale of parameters, and the number of parameters contained in each scale increases during the work until the end; this process demonstrates a kind of parametric serialism in which the parameter set is treated as a series.

The formal structure of the work consists of three sections., each defined by the number of elements that form part of the parametric scale. In the first section, the scales have two parameters. In the second part, I use scales formed by three parameters, and in the third part, I use four (the total parametrical chromatic scale, or series).

This structure is intended as a metaphor of the history of music. Scales formed by 4 parameters are a metaphor for a row of 12 notes, since both comprise the entire set of elements.

This formal structure, which is defined by the increase of the number of parameters in each section, uses the parameter concept as a principal element of formal structuring. And this structure is what defines cognitive-parametric music.

In other works, I have exploited the idea of a common element among other fragments using different parameters such as pitches, as seen in *The Sisyphus´ Regret*, *Jail Has the Name of Death* and *Parametric Neutralizations Studies*. In all of them, the common element was something concrete and tangible.

This work represents the various possibilities of parametric modulations as I modulate from a parameter of the first parameter scale to another parameter of the second scale. This technique is already used and largely anticipated in *Parametric Neutralizations Studies*, except that the parametric modulations were integrated into a formal structure determined for the neutralization of the parameters. My aim here is for the modulations to remain autonomous as they did in previous works where, instead of conditioning the significance of a parameter to another, they continue acting as the formal determiner themselves and not vice versa. This work is a formal consequence of modulating structures, whereas in others, the modulations were determined by formal neutralization processes of meanings, which were alien to them. As autonomous structures, the modulations were not subject to other global processes produced in the work.

All of this is to create music in which there is no single parameter that acts as the central one and determines the speech sound. The purpose is to create relativistic music in which there is no hint of a privileged center, (like a certain note in tonal music and its formal expression in structures, where the removal and subsequent return to a defined tonal center is the tension articulator of the speech), nor is there an element around which the speech sound is articulated (e.g., rhythm in Stravinsky's music, processes of material density in integral serialism, or timbral processes in the music of Scelsi and Ligeti). The objective is to liberate music from all its reference points.

Concept of space as a parameter inter-definition

Let us define the space (semiotic, not physical[50]) as an abstract concept as much as possible. Therefore, we will start from the idea that space itself does not preexist as things or objects, but the existence of such entities provides a framework where the space concept arouses .

Space is defined by the existence of an entity, one of whose attributes is capable of being configured in such a way to accept different values. Thus, space is defined as the distance between two points, which represents the different values that the parameter can assume. We create spaces when we create distances as differences between values.

For example, a sound object can be parameterized and physically defined by four properties: intensity, timbre, duration, and frequency of the main harmonic. Therefore, each of these parameters can generate its own space that is physical and “real" in the sense that it is measurable. With this in mind, we will now seek a way to inter-define the different parameters.

The parametric inter-definition must be achieved through an abstraction on what is common to both elements to be modulated. Abstraction takes place by drawing a concept of equivalence for each parameter with respect to a signification space between the identity of this signification spaces and what is used as a common element to modulate between fragments. This modulation is what we call a *modulation by interpolation* of a common parameter. It should be noted, however, that there is another type of modulation in which such interpolation has a literal function; in this particular type, it gradually passes from one fragment to another so that the beginning of the modulation resembles what is already at the end of what is going to come. Thus, we can easily understand the inter-definition of the signification space as an espourios correlation between the parameters. The determined parameters are correlated to the determiner parameters in much the same way.

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[50] Unless otherwise specified, we are talking about semiotic space rather than physical space. For a more detailed explanation, refer to chapter 2.

In the settling fact of the work, I develop the inter-definition of the signification space of three parameters. The first impulse of the work corresponds to a space in which the three parameters run freely throughout the range. Thus, over an interval of time, the intensity (from silence to the highest power attainable) and timbral complexity (from sinusoidal to noise) also run across the space's range. During the first part of the work, a direct determination of a parameter with respect to the others is established, so that the significance of a parameter is conditioned to the parameter that is determinant. The various parameters are inter-defined when their respective signification spaces are equivalent; in other words, when both are determined in the same manner by a third parameter.

That being said, the parametric modulation consists of the parametric inter-definition made possible through the equivalence of their signification spaces through a third parameter which acts as the determiner.

The signification space is a logical function that assigns significance to the given value of a difference between two points. In the modulations, a common element is used to modulate the inter-definition of various parameters through the equivalence of their signification spaces.

Another way to perform a parametric modulation is by releasing the function that a parameter has with respect to another; this occurs in *End Game* when the tautological moment is reached.

In the first passage of the first section of the work, a modulation strategy in which one parameter determines another is used (i.e., pitch determines dynamics). Then, this first parameter determines the other two parameters during modulation (i.e., pitch determines timbre and dynamics), which correlates to the signification space of the two parameters as determined by the first. Finally, the new parameter determines the first one (i.e., timbre determines pitch). This modulation is equivalent to a classical modulation by common element that creates two equivalent signification spaces between the two parameters determined during modulation.

Throughout the work, I frequently used different modulation strategies based on what I have just explained. The determining factors that forced

me to choose a specific modulation type are: the number of parameters in the scales, the common parameters to both scales, and whether or not the determiner parameters of the second scale is already present in the first scale.
How a parameter determines the others is not a fixed process; not only can it change the sense of the determination (direct or reverse), it can also change the way in which a parameter is determined. For example, pitches can be determined by the number of used pitches, for the cadential function, or by the difference between the current and previous note, and each one of these can be changed directly or inversely. We never exhaust all the possible permutations.

First section

The work begins by using scales with two parameters. By starting with a parameter set formed by the four parameters {pitch, duration, dynamics, timbre}, we create a subset of all possible combinations of the two elements' modulation between them.

We start from the following set of parameters:

{Pitch, duration, timbre, dynamics}

We begin with the following sequence of parameter subsets, listed below. It should be noted, however, that not all permutations are performed; a few are elided to attain some significance in the elections and provide some logic to the determination flow, which would be impossible if there were a perfect symmetry[51] among the permutations or all the combinations of two parameters were being used.

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[51] Despite the great number of symmetries used, symmetries regarding parameter scales are avoided. Also, the concrete symmetries used in the first bars should not be confused with

{**Pitch**, dynamic} {**Timbre**, pitch} {duration, **Dynamic**} {**Timbre**, dynamics} {timbre, **Pitch**}

In the first section, we have a symmetric structure if we consider it from the point of view of the central parameters (pitch, timbre, duration, timbre, pitch) and an asymmetric one from the perspective of the determined parameters (dynamic, pitch, dynamic, dynamics, timbre.) On the one hand, this dual symmetry creates a removal structure and the move back to the parametric key emulates the modulation structures in tonal classical music (symmetry). This symmetry closes the first incomplete circle, allowing cadential strategies to occur beyond this section. On the other hand, this symmetry avoids duplication and permits listening with more variety and ambiguity (asymmetric). Dynamics are explicitly elided as a parameter determiner, which will be explained in more detail in the following section. In what follows, the parameter that act as the determiner will be written in bold.
We as the first subset {**Pitch,** dynamic} as the first subset because it more clearly establishes, from a cognitive point of view, the determination flow. For the same reason, we continue with {pitch, **Timbre**} because it permits an easy modulation. In the following section, we perform an inversion of the last elements as an axis section to allow for a different modulation strategy. To avoid symmetry, we choose a set that has no parameters in common with the previous set.
An incomplete cycle of modulations is provided.

Bars 1–6

In the first six bars of the work, a series of pitches is matched with the number of notes, and pitches determine dynamics. The remaining parameters (notes, duration, and timbre) do not vary or remain almost

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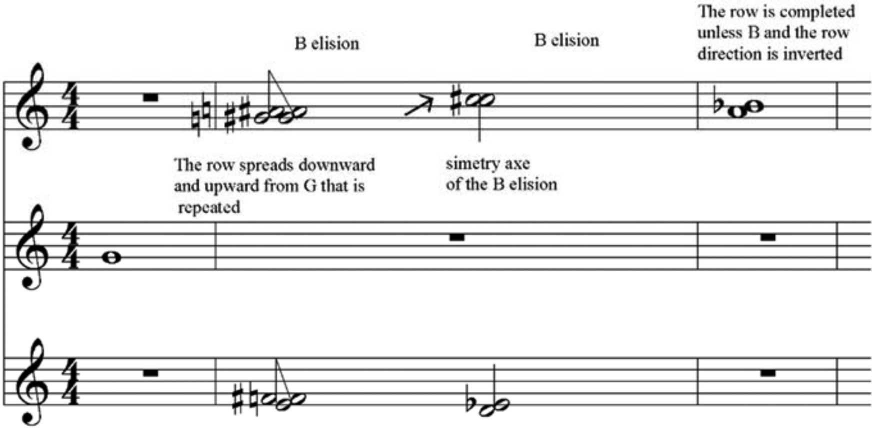
parametric structural symmetries. Keep in mind what has been said about the symmetry functions in *Parametric Neutralization Studies* in regard to pattern recognition.

stable and neutralized. There is one exception, however; small variations serve to reinforce the settling of the pitches as the central determinant parameter of dynamics. This exception is necessary because we are in the process of settling fact.

ppp	1 event
pp	2 events
p	3 events
mp	4 events
mf	5 events
f	6 events
ff	7 events

We will not use *p* = 3 events to make possible the *ff-mp* inversion. And *mp* must appear three times so that the last chords of each of the 3 sets of 12 events resolves on *mp*.

This first sentence is divided into 3 parts, each of which consists of 3 chords. The sum of events for each of these chords is always equal to 12; the chord that starts or ends each of the 3 groups of 12 notes is a whole note, while the rest have a half note duration. This allows the inversion of the infinite series produced in the last bar to validate false relationships later on.

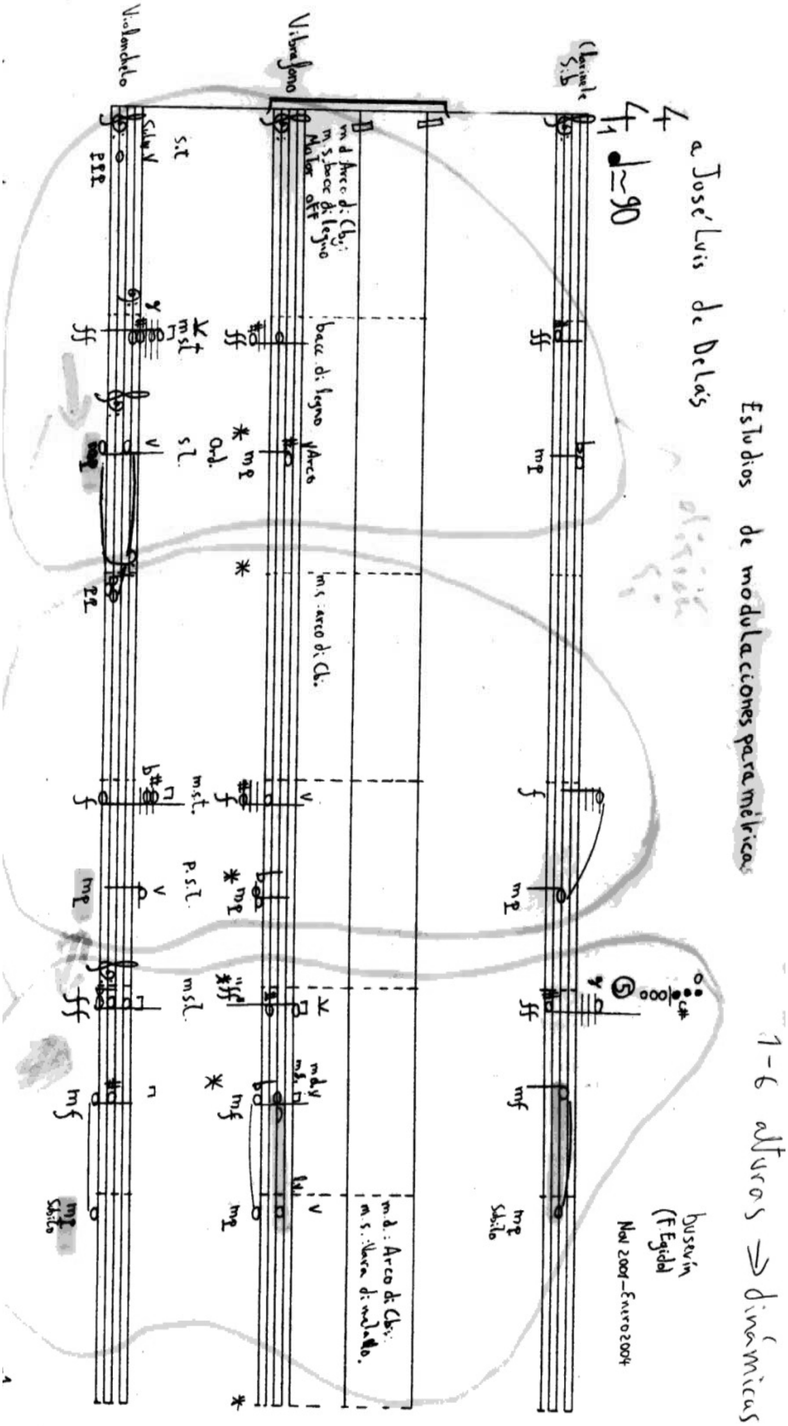

B elision
B elision
The row is completed unless B and the row direction is inverted
The row spreads downward and upward from G that is repeated
simetry axe of the B elision

Pitches follow the sequence of the infinite series, thereby achieving the greatest possible indifferentiation. However, when it is time for the turn to *B* in the second chord, a *G* is used instead, so the *B* is elided (for a function similar to the dynamics in the *mp* elision). Since *G* is present in the chord before and adjacent to the cluster formed by this chord, its occurrence is not alien and therefore is allowed. In the fourth chord, the *B* is elided again in the fourth bar (in the Alcala's score, there are several errata and false notes) achieving that the chord *C-C sharp* works as symmetry axis regarding the elision. In the second group, *B* is no longer elided; in fact, it is the last note in this group following the infinite series, used only on the *mp* chord. In the first chord of bar 5, the infinite series is inverted using just the axis created by the inversion *mp-ff*; the last note to appear is *B* so that it can cadencialy resolve to *B*.

This first sentence can be regarded as the settling fact, so it is longer than other sentences. The {**Pitch**, dynamics} scale is used so that pitch, as the determining parameter of dynamics, can establish the determinations flow. This is used because pitch is the parameter that most commonly determines the musical speech and pitches are easily established as determinants (cognitive rule). Dynamics are selected instead of timbre or durations because it is a parameter that better establishes the determination flow. Another axis of symmetry is then created by reversing the order of the apparition of the two dynamics that are used twice (*ff-mp* | *mp-ff*).

The final cadenciation is made on *B-C* to *C-B,* which lacks real harmonic motion.

Next page: first page of the manuscript score with analytical annotations (a color version can be found at http://busevine.wordpress.com).


Estudios de modulaciones paramétricas
1-6 alturas ⇒ dinámicas
a José Luis de Delás
busevín
(F. Egido)
Nov 2001–Enero2004
4/4
♩≃90
Clarinete S.b
Vibrafono
Violonchelo
m.d. Arco di Cb.
m.s. bacc di legno
Motor off
bacc di legno
Arco
m.s. arco di Cb.
m.d.: Arco di Cb.
m.s.: bacc di metallo
Solo V
s.t.
m.s.t.
s.t.
Ord.
m.s.t.
p.s.t.
m.s.t.
m.d.y
ppp
ff
mp
pp
f
mf
Subito

Bars 7–9

These bars correspond to the first modulation. We modulate between the parameter’s scale {**Pitch**, dynamics} to {**Timbre**, pitch} using as common element: the number of pitches. In the first six bars, the number of simultaneous pitches determines the dynamics; in the following bars, the number of pitches will be determined by the timbre.

The modulation is a transition during which the number of pitches determines both the dynamics and timbre. The timbre is treated as a space ranging from a single harmonic to the overlapping of many harmonics (noise). The sinusoidal timbre is associated with a single note, while noisy timbres are associated to a cluster of notes. Apparently, the pitch seems to be the most active and important, i.e., it starts determining the dynamics and becomes to be determined by the timbre. Modulation moves from a fragment in which the pitches determine the dynamics to one in which the timbre determines the pitch.

However, the determination is in principle reversible; it is just as valid to say that pitches determine the dynamics as is it to say that dynamics determine the pitch. Indeed, the function of the modulation is to make the pitch become a determining parameter during modulationthus defining the other two. (This means that pitch is settled as the central parameter.) However, there is also a weaker second reading; we could even say that the pitch goes from being determined by the dynamics to being determined by the timbre. The infinite series is followed[52] throughout the modulation. To avoid this second reading, I avoid using the dynamics as a determiner parameter until much later in the work.

Although , formally, there is an *a priori* determination flow in the work, the determining flow direction is established during the listening time depending on each particular listening, so we are always looking for ambiguity. At the beginning of the work, we create determination flows through cognitive strategies to reverse these flows and allow a free decoding of all these elements that become unreferenced.

This modulation comprises three sound objects that remain neutralized for a bar. In the first sound object, the cello note slowly becomes more sinusoidal in its timbre, which continuously reduces dynamics. In the second sound object, we have a total of six notes at *ff* and with "noise" timbres: overpressure in cello and broken sound on the clarinet. Finally, in the third bar, we have a harmonic in the solo clarinet.

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[52] For more detailed explanation see the *End Game* analysis.

Along these lines, the relationship between the number of notes regarding the timbre and dynamics is established.

Bars 10–12

This fragment is a process of fouling a note. The timbre determines the number of notes adjacent to the main note. The closer the sound is to noise, the more notes it contains. When the sound is almost sinusoidal, there is only a single note. Dynamics have been neutralized and remain almost constant. A *p* dynamic is used because it is the most convenient dynamic from the point of view of instrumental techniques nearest to *mp*, which is the dynamic associated with rest in the first section of the work and is therefore the most neutral. The aim is to achieve greater dynamic neutralization.

The set {pitch, **Timbre**} has been chosen because the pitch parameter must be present and is common to both parameter scales. Timbre was chosen because it could not be repeated again. It also is easier to relate the timbre with a number of notes than with durations. The pitch here stops following the infinite series, and instead follows *D sharp* (as a continuation of the infinite series). While *A flat* appears to break this logic, we used it in the percussion because it repeats the previous percussion note of the gong. This allows the logic of the infinite series to remain intact, making a smooth transition between the infinite series and its gradual vanishing. The infinite series is broken because pitch is no longer the central parameter. The *E* on the cello is, therefore, the first note that does not follow the infinite series and is considered a cognitive dissonance. Pitch neutralization is established around this note or any other nearby.

This section consists of a single gesture of timbral evolution: more notes appear as the timbre becomes more "noisy."

Bars 13–15

Modulation is produced from {**Timbre**-pitch} to {**Duration**-dynamics}. We choose a scale that has no common parameter to the previous one to allow for a new type of modulation between scales of parameters that have no common parameter. This modulation is used differently than the the strategy implemented in the first modulation and involves some kind of interpolation between the two fragments. If we had followed the same scheme as the first modulation, then timbre would had determined the number of notes and dynamics, but instead, all parameters become neutralized and only the timbre changes. The function of this strategy is to avoid performing the same modulation repeatedly. The timbre plays the most important role in the modulation because it is the parameter that was determining the rest of the parameters in the previous fragment.

Since there is no common parameter between the two parameter scales to be modulated, the same strategy from the previous modulation cannot be used. So, instead of making a common parameter to determine the other parameters, the parameter that was previously the only determinant is now not neutralized, while all the others are. The pitch is frozen in *G*, which is already prepared in the previous fragment and is the most neutral pitch (with which the work begins). Dynamics are frozen around *mp*, although there are small variations mainly derived from instrumental actions. The durations are neutralized by the long duration of the events.

Bars 16–18

In this fragment, a series of durations determines the dynamic grade by the following relationship:

4*p* = 4 quarter notes
2*p* = 3 quarter notes
mp = 2 quarter notes
f = 1 quarter note

Each dynamic grade reduces inversely by an eighth note. As seen before, we have chosen a few parameters that complemented the previous two so that there were no common elements between the two scales of parameters. The pitches are neutralized around *G*. For the first time in the work, the polarity of correlation is inverted, i.e., the maximum value of a parameter correlates inversely with the minimum value of the other. This prepared a weak cadenciation at the end of the first section.

One way of producing parametric cadences is by inverting the way that a parameter determines another. For example, if a parameter directly determines another and later determines the same parameter inversely, a cognitive tension occurs during that period. The resolution of this tension can be achieved by returning to the direct determination and creating a cadence. However, the inversion of a direct or inverse determination (polarity) should not be confused with the inversion of the determination flow (i.e., a parameter that determined a second parameter is now determined by the second one).

Now, by taking into account the occurrence of such inversion in the determination flows and the type of determination, it is necessary to introduce a reverse determination. It was impossible to perform one before because – and this is important – during the early parts of the work, the types of determination were the same and more obvious (the direct) for cognitively reinforcing a parameter's determination of the others. This cadential form can only be introduced once this task is done, bringing forth an inverse determination.

We also decided that the first appearance of inverse determination occurs immediately upon the dynamics' reappearance as a parameter that is determined, since it was the first to function in such a way.

Bars 19–21

Another modulation in produced in the following passage so that the timbre and dynamics determine, in a rough very manner, the durations. Such a rough modulation is possible and functional because, to the extent that we have moved away from the settling fact and are now approaching the tautological moment,[53] the inaccuracies are becoming more acceptable and somehow allow both determinations to come into certain conflict.

The relations are:

- Low dynamics, shorter duration, and sinusoidal sound (relative to each instrument)
- High dynamics, more harmonics, and longer durations

This modulation produces an inversion of the type of determination and determination flow from their previous appearance. The function of this inversion is the cadential preparation at the end of this section. If the durations of earlier fragments were determined by the dynamics in an inverse determination, it is now determined through a direct determination. This operation becomes possible when the dynamics are the privileged parameter, precisely because dynamics have never been the center, and it is the parameter on which floats a parametric retard that will be resolved a bit later.

The dynamics have the same function, in terms of the scale of parameters, as *B* to the row of 12 notes at the beginning of the work. They are therefore a privileged parameter.

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[53] For a further detailed explanation about tautological moment, see my analysis of *End Game*.

Bars 22–24

In this fragment, timbre determines dynamics. The sounds that are more sinusoidal in timbre have a low dynamic, while more noisy ones have high dynamics. The durations and pitches are neutralized around *D*. This fragment is constituted by a single sound object that evolves from *ppp* with a sinusoidal like sound (harmonic), to an overpressure with a broken sound in *fff*.

Bars 25–30

Finally, the section ends with a coda in which the determination flows are inversed in the same way as they were in the first sentence of the first section. This similarity is like a cadence from the first section, in a similar manner in which the flow of infinite series was inverted in the first sentence of the work. This phrase prepares listeners for the second section and acts as a transition, closing the initial cycle. The function of this coda is to break the determination flows, so any parameter determines any other in a very clear manner. Quite relatively, pitches determine the timbre, thus reversing the determination of the third sentence and the second scale. This parameter scale was chosen because it has appeared previously, and one of its parameters is one of the most important of the entire first section. This is particularly exemplified in bars 25–26 in the vibraphone when the determination flow is inversed; a greater quantity of notes now implies a soft dynamic rather than a loud one. The rest of the parameters are almost neutralized, although the instrumentalists may have to fight their natural tendencies in regard to the dynamics. If strong dynamics were involved before the noisy timbres, they would now imply sinusoidal sounds (only in an intermediate form, as it is not always so obvious). The determination flow is thus inverted.

The infinite series reappears in this section, but from two different directions. The vibraphone moves downward to the *D* from the previous section, while the clarinet takes the *F* from bar 21 and passes to *D* in bar

21, which is taken as part of the infinite series in a line from bar 25 by the clarinet. This coda does not resolve on *B* because the note holds no conclusive character. The section closes using a similar mechanism from the beginning of the section. There are now two simultaneous infinite series that are meant to cause a lot of ambiguity.

This section is a brief conclusive cadence formed by all the elements that constitute it. This kind of cadence is very partial and interrupted in order to anticipate and transition us into the second section.

Recapitulation

The dynamics have never determined any parameters, so it is the most passive or elided parameter, while pitch has determined the most parameters.

We have seen two different types of modulations: one in which there is a common parameter between the two-parameter scales to be modulated, and another in which there is not a common parameter. In the first type, the common parameter serves as a common element for modulating because it determines the other two. When there is not a common parameter, the strategy is to neutralize all parameters except the one that was decisive in the first parameter scale.

In addition, the first section of the work uses symmetry between these forms of modulation; therefore, the arrangement of the modulation parameters and the removal and return to the main parameter settle the form. This is what establishes the meaning of cognitive-parametric music: it is a type of music where the concept of parameter is a musical material and a musical object structured by musical form. We will also see another element of parametric formal structuration because each of the three sections of the piece has a parametric relationship established by increasing the number of parameters from the parameter scales.

Second section

The second section begins in bar 30. In this section, the scale of parameters is formed by three parameters instead of two like the first section. This incremental directionality stems from a kind of representation of the history of music. The recent history of Western music is metaphorically understood as an increase in the number of notes used in scales up to serialism, which is represented in the third section by scales with all parameters. The formal structure of the work is directional in the sense that it parts from simple and two-parameter scale modulations and continues with more complex ones that involve more parameters and finally leads to a climax that emulates parametric serialism in which there are no modulations. While the pitches initiated and resolved the first section, it is the durations that function in this way in the second section.

The scales used in this section are:

{**Duration**, timbre, pitch}, {**Dynamics**, pitch, timbre}, {**Pitch**, duration, timbre}, {**Timbre**, duration, dynamics}, {**Duration**, dynamics, pitch}

First sentence of the second section (30–33)

The duration of the notes determines pitches (as the number of notes rather than the pitches themselves, i.e., many notes indicate a shorter duration while a single note indicates a long duration) and the timbre of the sounds. Here, the relationship established in the first section is inverted: noise implies longer notes and sinusoidal timbres imply short notes. In the first cluster, the pitches follow the infinite series, but later they are neutralized around *A*. In the first section, the central parameter determined the other member of the scale in each subsection while the other two remained neutralized, but in this section, the central parameter determines the other two members of the scale. The parameter that is not part of the scale is neutralized.

First modulation of the second section (34–37)

The second sentence modulates by changing the central parameter from duration to dynamics. The new modulation corresponds to the bars (34-37). In this modulation, the timbre is used as a common element that is now determined by dynamics rather than duration. A particular timbre transformation is used as a common element between the two phrases that are modulated by the same kind of interpolation; however, the transformation was determined earlier by the duration of the notes, but it now indicated by the dynamics.

This modulation occurs around two sound objects, each one lasting about two bars. In the first sound object, pitch and dynamics are neutralized; it is a gesture of timbre evolution over time. The timbral change process over time occurs between the clarinet and the cello, both of which are always on the same *G*. The clarinet begins with an airy timbre and moves toward a normal sound, while the cello begins with a normal timbre to one of little pressure with harmonics (very similar to clarinet air). As a result, the changing timbre becomes associated with duration.

In the second timbral sound object, the evolution of the timbral change is related to the dynamics, which are no longer neutralized. There is a *forte* attack consisting of an undetermined pitch in the clarinet and an overpressure technique in the cello that goes from a noisy timbre at a *forte* dynamic to a flautando sound consisting of a *mf* harmonic without pressure. With this combination, the two modulation types are mixed: one a common parameter and the other an interpolative parameter. This modulation is a kind of interpolation to the extent that the first gesture resembles the former (timbre is determined by duration) and the second anticipates what is coming (timbre is determined by the dynamics). Moreover, timbre acts as a common element: it was determined in the first part by the duration, and in the second by dynamics. This type of modulation changes in a way similar to what occurred in the first section, where the intermediary parameter is the determined entity rather than the determiner. In general, modulations between three parameters' scales are easiest since a central common parameter between any of the two scales is not a requirement.

Dynamics are elided as a determining parameter in an environment in which the scales are formed by two parameters until all three parameters' scales are present, thus reinforcing a gradual increase in the number of parameters in the scales within the system. Furthermore, this elision anticipates the total parametric completeness of the four-parameter scale.

Second sentence of the second section (38–43)

The new parameter scale extends over bars 38–43. During these bars, dynamics are the main parameter that determines the others, which means that louder dynamics indicate noisier timbres and a larger quantity of notes. The time is now neutralized for two bars events (there are three). This section is a little longer, and it is very important to stress that it is the first time that dynamic is playing the role as central parameter.

Remember that throughout the first section. This section reaches a kind of full parametric chromatism, in the same way the *B* in the first part of the first section was elided to complete the total chromatic when it appeared. At the structural level of the work, the dynamics' elision as a determinant allows us to complete the total of the determining parameters at a later point in the piece: this process acts as a kind of parametric retard. The first elided parameter in the first part of the work was dynamics, since it was determined by the pitches in the settling fact at the beginning. It was necessary at the time to emphasize the determining functions, and that the first parameter to be determined continued to be determined until all parameters acted in this role, which helped to establish the determination flow. Thus, this section highlights the fact that, for the first time, all the parameters have been determiners; this closes the circle and leads to a parametric cadence flavor that is stronger the longer it is maintained in the retard. We see here yet another way to create cadential parametric structures through a parametric retard, formally organized through a parametric structure, that allows us to organize different moments of the work with respect to the formal parametric functionality.

The first section of the work can thus be understood as a subtle metaphor that anticipates the remainder of the work. The *B* elision is an anticipation of the dynamics' elision: the first phrase is taken and transposed parametrically, while the *B* elision from the pitch scale is parametrically transposed to the dynamics' elision from the parameters' scale of the whole work. The dynamics assume the function of *B* in the parametric scale.

Second modulation of the second section (44–47)

At this point, it is not possible to modulate to a new parameter since the two parameters being used in the modulations are already present in the scale. This implies a curious phenomenon in which the modulation occurs at the pitch parameter since it is already present; therefore, to make this modulation clearer, the equivalence of the pitches as an amount changes to a process based on false resolution cadences (44–47). The moments of relaxation in the process of false resolutions coincide with long durations and sinusoidal timbres, while the tense moments are represented by short durations and noisy timbres.

For this process, I rely on the first sentence of the work in which there are techniques such as a number of equivalences and suspended resolutions.

Third sentence of the second section (48–49)

These two bars use the same determination of the modulation, i.e., the relaxations in the tension control and determine the duration and timbre, while pitches determine the remaining parameters. The resolutions are produced on long notes, and pitch determines noise in the tension moments and sinusoidal timbres in the relaxation moments.

Third modulation of the second section (50–51)

The following modulation transitions from {**Pitch**, timbre, duration} to {**Timbre**, dynamics, duration} to make a new common parameter modulation. The only common yet not determined parameter is duration, so timbre and pitch determine this element in the same way they did in the previous sections. Sinusoidal timbres and long notes imply relaxed pitches, while harmonic tension implies noisy timbres and short notes.

Fourth sentence of the second section (52–53)

In this sentence, timbre determines dynamics and duration, so noisy timbres indicate short notes, while sinusoidal timbres indicate long ones. Additionally, noisy timbres are louder, and sinusoidal timbres are quieter. The pitches are neutralized again around *G*.

Fourth modulation of the second section (54–55)

In these two measures, a modulation occurs to identify duration as the central parameter (like the beginning of the second section), but this time, duration determines dynamics and timbre rather than pitch. During the modulation process, dynamics are used as a common parameter by being determined by both the timbre and duration, meaning that short durations imply noisy timbres and louder dynamics, while long durations imply sinusoidal timbres and quieter dynamics.

Fifth sentence of the second section (56–59)

In this sentence, duration determines dynamics and timbre rather than pitch: an increased dynamic implies a longer duration and larger quantity of notes. This section consists of three sound objects of increasing duration. The first lasts three quarter notes, the second five, and the third six; the pitches are free, although the leap from one note to the next is greater when the dynamic is louder. Each of these events consists of an attack and sustain; the sustain is always carried out by the clarinet, the attack by percussion, and the cello with Cl. Batt. As a consequence, the sounds are expected to last until the beginning of the next note despite their shortness; dynamics are applied to the period as a whole rather than the actual duration of the sounds.

This approach prepares us for the third part of the piece, which is going to use this same form of sound objects. As we approach the end of the first section, the music becomes much wilder as all of the instruments being to demonstrate more freedom in their playing; with so many exceptions to the rules being made, cadenciation is no longer necessary. So many degrees of complexity have been reached, and there have already numerous inversions between determination flows and determinations sense (polarity), so the same strategy is no longer possible. A return to duration as a settled and central parameter closes the cycle of the second section.

Third section

What characterizes this section is the use of parameter scales from 4 parameters. The third section has two parts.

In this section, there is only one constant modulation process without fixed reference points and without settled parametric centers, in which parametric modulations occur between scales of four parameters. In this section, a common element is no longer used. Modulations are hard, representing the beginning of the dissolution of parametric tonality. (Just as modulations in late tonal music are very hard, abruptly changing the tonality without any common element or transition.) In the second part of the piece, parametric modulations cease to exist and only a single parameter scale is serialized. This process may be a breakthrough in integral serialism because not only are all parameters serialized, but so are the set of parameters.

The central problem generated here is that we must modulate to parameters already present, which requires creating a similar type of structure as in *Parametric Neutralizations Studies*. In addition, if the parameters are all neutralized, the section may be identical to the first.

Since only four parameters are considered in this work, which means that the maximum parameter scale comprises four parameters, there are only four total possibilities. In addition, modulations do not exist in this section, so duration of the parts must be necessarily shorter than the others (12 bars, 3 bars for each parameter scale). The fact that the duration of this part of the work is shorter is explained by the absence of modulations. Indeed, this section looks like the beginning of *Parametric Neutralizations Studies*. In a way, this piece is an inversion of that earlier work: what in *Parametric Neutralizations Studies* was the settling fact is here the tautological moment, and vice versa.

General scheme

First part		Second part	
60–62	63–65	66–69	70–72
Dynamics	Duration	Pitches	Timbre
duration	pitches	timbre	dynamic
pitches	timbre	dynamics	durations
timbre	dynamics	duration	pitches

Section 3 part 1

Bars 60–62

In the first three bars, the determinant parameter is dynamics. In general, this section inverses the ways that a parameter determined others (changing the polarity) in the first two sections of the work. For example, since a louder dynamic involved short durations and a quieter dynamic involved long durations in bars 16–18, and noisier timbres implies louder dynamics and a larger quantity of notes in bars 38–44, these orders will be reversed in this section. A circle is also completed in the sense that, in the second section of the work, dynamics determined the two parameters that were not determined in the first section of the work. This closing of the circles, which is based on the asymmetry of the parameter scales and the elision of some of them, generates a speech with cognitive tension and relaxation (cognitive dissonances) equivalent to the distance to and from the tonal center in tonal music. Therefore, symmetries are established in other planes to compensate for the lack of structural symmetry that is created to balance the form.

Silence molto expresivo means imagining a noise at such a low volume that it cannot be heard, like a noise spectrum at an infinitesimally low volume. This has a structural meaning, as this kind of silence is structurally very different from the previous one, and although two silences cannot be directly articulated in any way, two silences can have very distinct structural significances. But this difference has another implication because they are two different units: one silence represents the end of one section and the other silence the beginning of another. The fact that they cannot be articulated musically as something different indicates a difference between the levels of listening and structure, a revelation that is so dear to my music. From the point of view of interpretation, does not mean anything.

Silence molto expresivo sounds like any other silence, but maybe if the musician understands precisely what it means, then the two silences are heard differently. To more accurately represent the second as an infinitesimal and absurd silence, the instrumentalist could act and gesture in a way that does not produce any sound so that, at least visually, any member of the public watching the play could intuit that something different is happening instead of listening.

The dynamics are the chosen parameter to determine others as a kind of inverse recapitulation of the first sentence of the first section, where they functioned as the parameter to be determined.

From the viewpoint of the pitches, the same procedure of the infinite series is used except that the octave is divided into 8 subdivisions instead of 12 to create an equidistant 8-note scale over an interval of 3/4 tone instead of a semitone. The scale used is:

C# - D𝄲 - E - F𝄲 - G - A𝄲 - A# - B

Like a structural hook, the *A𝄲* in the first chord, which is foreign to this logic, serves as a transition from the earlier fragment.

There are 7 events who correlate in the following manner:

Event	Dynamics	Duration	Note number	Timbre
1	null	null	infinite	noise
2	*ppppp*	eighth note	6	almost noise
3	*ppp*	quarter note in fifths	5	Noise and sawtooth
4	*p*	quarter note and eighth note	4	sawtooth
5	*mf*	quarter note and eighth note in thirds	3	triangular
6	*ff*	half note and quarter note in thirds	2	triangular + sinusoidal
7	*ffff*	whole note	1	sinusoidal

The duration series is obtained utilizing this recursive succession. The left duration is divided by three: 12 quarter notes/3 = 4 quarter notes = whole note, 12 quarter notes - 4 quarter notes/3 = 2.66 quarter notes = half note and two eighth notes in thirds, 16 eighth notes - 5 eighth notes/3 = 3.66 eighth notes, etc.

Bars 63–65

In the second sentence, the duration determines the rest of the parameters. The duration in the first section determines the timbre and determines the timbre and pitches in the second section. The duration has never determined the dynamics, so the most obvious direct determination is established and longer notes have a louder dynamic. The correlation is not exact, however; some of the same dynamics may correspond to various durations.

The timbre is determined twice in the first section (a longer duration implies sinusoidal timbres) and involved noise in the second section (long durations imply sinusoidal timbres). In the second section, duration determines the pitches so that a longer note would imply a larger number of pitches. Here, the way in which the duration determines the frequencies it is inversed, using *E* as the resolution center to imply long notes.

Bars 66–69

In this sentence, pitches determine the other parameters. In the first sentence of the first section of the work, pitches determined the dynamic (i.e., a greater number of pitches implied a louder dynamic). In the second section, the pitch determined the duration and timbre. But now, it is cadenciations rather than the number of notes that indicate long notes and sinusoidal timbres: the circle closes again. (Note that I alternate the parameters that have closed the determination circle and the ones that have not to formally balance the work.) In this fragment, cadences are produced in the same manner. The determination flows of the first section are repeated as a way of preparing listeners for the end of the piece. With this repetition, listeners recognize certain objects as familiar, which simulates the return after the modulation cycle to the main key. The phrase resolves on *B,* like in the first section of the work. Note that there is an infinite series of fifths increased by a quarter tone (15 quarter-tones interval) beginning in bar 56, which makes this section begin on *D*𝄲 in order to continue the downward infinite series without inversions from the previous fragment. It has to finish next time on *B𝄲*, resolving on *B* instead on *B demisharp*.

Since we used a scale of eighth notes, the 3 bars are now divided in 7 durations. A similar procedure is used in the previous sentence and begins with a *D𝄲* in harmonics. This is the continuation of *D* following the infinite series of the frozen *E* that descended in the previous sentence. The clarinet performs an ascending series using a sixth demiflat, which determines the rest of the number of notes in each chord and therefore its duration.

This sentence poses a very difficult problem. In this third part of the work, there are no longer any modulations, so a single parameter determines the other three in each of the four sentences, but to allow each sentence to have a differential nature, there must be a way to change how a parameter determines the others. This is another reason why the determinations flows are inversed and why, in the second sentence of the third section, the pitches also assume one of two functions: resolutions (through the clarinet) resolving on *B demisharp* to allow a *B* final resolution, and to indicate the number of notes.

Now that the pitches determine the number of notes, it is necessary to determine the other elements in a clear and differentiated way in regard to the first sentence. To do this, there is an upward gesture in the dynamics in the first sentence that, as the main parameter, determines everything that happens by indicating an upward gesture of pitches at a fixed interval.

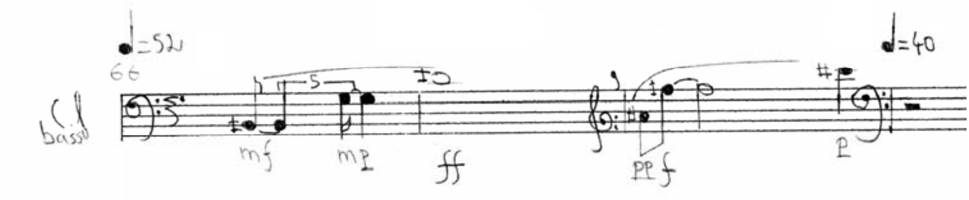
But first, let's establish the table of seven correlated events:

Event	Dynamics	Durations	Number of notes	Timbre
1	*ff*	whole note	7	Noise
2	*f*	half note with eighth note	6	noise + sawtooth
3	*ppp* (should be *mf* but it is inverted)	dotted quarter note	1	sinusoidal (should be almost noise) noise + sawtooth
4	*mf*	four eighth notes in fifths and eighth note	5	sawtooth
5	*mp*	eighth note in fifths and a quarter note	4	triangular
6	*p*	quarter note	3	triangular + sinusoidal
7	*pp*	eighth note	2	sinusoidal

The difference in the first sentence is that the sequence of elements is determined by the sequence of pitches rather than the dynamics. That a parameter determines others means so that it decides which parameter will govern or determine the order of events. Additionally, determination flows are inverted in relation to the other sentence.

D𝄲 is an exception (in terms of duration) that works as a pivot between the two sides of the third section. This section follows the logic that a single note indicates a sinusoidal timbre (i.e., harmonic sounds, but the dynamic and duration are inconsistent with this section).

To allow the pitches to determine the rest of the pitches, the clarinet plays an upwards scale formed by fifths increased by a quarter tone, which produces the scale that divides the octave into 8 parts (*C# - D𝄲 - E – F𝄲 - G - A𝄳 - A# - B𝄲*).



Then, given the sequence of notes *B𝄲 - G – D𝄲 - A# - F𝄲 - C#.* The number of notes in the cluster is determined by the need to fill the phases, but because the space is identical in all, we are going to use various stratagems to allow a difference number of notes in each case, and for the clarinet note to be in the range of cluster notes. Elision is permitted if notes are not consecutive. It is also allowed on the repetition of the first and the last note of the cluster but can only be used on one of the seven events described.

B𝄳rp begins the sequence for the aforementioned reason.

The next note is *G*: we take the note between the *D𝄳* (note that indicates a deviation from the infinite series of this 8-note scale) and the *G* (5), which is the *B𝄳*.

We use event 5.

The next note is *D𝄳*; since there are four notes between this note and the *G*, we will use those four notes to choose event number 4.

The next chosen event is 7 since it is the axis of this fragment, and *B* acts as a privileged place in the axis. To elide between two notes, elision needed to prepare the resolution of *B* because *B𝄲* itself is elided, and *F𝄲* is, like *E,* one of the notes furthest from *B𝄲*.

A *C sharp* is used to finish the series in this event since its distance to *A sharp* is just one note. We choose the smallest event we have (2, 6, and 3) to generate the greatest contrast in the numbers of notes between events, but we look to finish in *B𝄲* because some notes are repeated in the beginning and end of the clusters.

Bars 69–72

In the first section, the timbre (increasing harmonic content) determines the dynamics. In the second section, the timbre determines the dynamics and duration. Again, there is a parameter that still has not been determined by timbre: pitch.

To prepare the final, determinations are very similar to the previous ones and the pitch is set to *B*, as a neutralized resolution, and by using a kind of parametric ritardando neutralized on *B* (only the number of notes played a minimum role in this technique). As we have seen in the previous sentence, the infinite series finishes descending on *B demisharp*; therefore, the note that would naturally follow is *B* to indicate the infinite series of the first sentence of the first section instead of the 8-note series used in this section.

In general, short notes here involve louder dynamics and noisier timbres, with the same exceptions; however, instead of a table of equivalences, a kind of parametric rallentando occurs this time.

There is a timbre melody composed of three elements (noise, sinusoidal, sawtooth) that is repeated twice with a relatively proportional gradation (see following table).

Timbre	
6	pizz. Bartok
5	vib. bacc. di legno (The gradation is relative to each one of the two gestures.)
4	cl. battutto
3	clarinet and cello
2	vibraphone with bow + clarinet
1	harmonics

First gesture:

Dynamics	Durations	Timbre
ff	eighth note	6
mf	quarter note with an eighth note in fifths	2
p	four eighth notes in fifths	4

In the second gesture, dynamics reduce by one degree and the durations are reduced proportionally.

Dynamics	Durations	Timbre
f	quarter note in thirds	5
mp	quarter note and eighth note in thirds	1
pp	whole note	2

Section 1 modulations between two parameter scales

First part symmetry. Common element modulation acts as symmetry axis.			Modulation as symmetry axis.	Second part symmetry. Common element modulation acts as symmetry axis.			Second and third sections transition.
1sentence (1-6) {***pitch,*** dynamics} Higher number of notes determine higher dynamics.	**2 sentence (7-9)** First modulation by common element **pitches** determine dynamics and timbre. higher dynamics determine an higher number of notes and noisy timbre.	**3 sentence (10-12)** {***timbre,*** pitch} **Timbre** determines pitch. Noisy timbre determines higher number of notes.	**4 sentence (13-15)** second modulation. First Interpolation modulation.	**5 sentence (16-18)** {***duration,*** dynamics} Durations determine dynamics. Long duration determines low dynamics.	**6 sentence (19-21)** Third modulation. Second modulation by common element. **Dynamics** determines duration and timbre. Low dynamics determines short duration and higher dynamics determines higher harmonic content.	**7 sentence (22-24)** {***timbre,*** dynamics} **Timbre determines dynamics.** Low harmonic content determines low dynamics.	**8 sentence (25-30)** {***dynamics,*** pitch} Determination Flow Inversion (1 sentence). Lower dynamics determines higher number of notes.

Section 2 modulations between three parameter scales

1 sentence (30-33) {***duration,*** timbre, pitch} Short Duration determines higher number of notes. Long duration determines noisy timbres	**2 sentence (34-37)** **1 modulation** By common parameter and interpolation	**3 sentence (38-43)** {***dynamics*** timbre, pitch} high dynamics determines higher number of notes and noisy timbre	**4 sentence (44-47)** **2 modulation** by function change modulation	**5 sentence (48-49)** {***Pitch,*** timbre, duration} Resolution determines long notes and sinusoidal like sounds.	**6 sentence (50-51)** **3 modulation** By common parameter pitches and timbre determine durations as common parameter	**7 sentence (52-53)** {***timbre,* dynamics,** duration} Noisy timbre determines short notes and forte dynamics.	**8 sentence (54-55)** **4 modulation by common parameter** dynamics is determined by duration and timbre	**9 sentence (56-59)** {***duration,* dynamics,** pitch} Higher dynamics determine long notes and higher number of notes

Section 3 four parameters serialized scales

1 sentence (60-62) {***dynamics,* timbre**, pitch, duration} Higher dynamics determine few numbers of notes, longer durations and sinusoidal like timbre.	**2 sentence (63-65)** {***duration,*** timbre, pitch, dynamics} Higher durations determine higher dynamics noisy like sounds and higher number of notes	**3 sentence (63-65)** {***pitch,*** timbre, duration , dynamics} Higher number of notes determine higher dynamics, long duration and noisy timbre.	**4 sentence (63-65)** {***timbre,*** pitch, duration , dynamics} Noisy timbre determines fewer number of notes, shorter durations and higher dynamics.

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7. Analysis of parametric formalization studies

Introduction

The work represents the synthesis of four problems. For one, I needed to formalize and systematize the use of parameters as sound material more accurately than I did in my previous two studies. In regard to the issue of time as sound material, I also wanted to try the problem of relativity in listening. Finally, I wanted to replace the concept of settling fact so that it would not be necessary to establish some determination flows through a central parameter, even in a rotative manner.

The result of the synthesis of these four problems has been the creation of an abstract formal system of relativity that formalizes a theory on the relativity of musical time. In this way, I discovered something that was not initially a problem, but eventually became much important than the problem itself: memory. This is because *the relationship between memory and movement implies the significance of the relativity of time*. Thus, by using certain parametric relations and basic architectural materials for the structure, this work tries to build a solution to a strictly musical material problem (or at least a "sound material" problem, if you do not grant me permission to call what I do "music").

Relativity is, to me, a very important concept. Against the pretensions of an absolute knowledge, I have always claimed that all knowledge is relative to something else. By relativity, I do not mean Einstein's relativity, but rather a version of pre-Einstenian relativity that is applicable to almost all fields of knowledge.

The concept of relativity has always been present in my music with the idea that listening works independently of the composer's intentions and is relative to the person who listens, with even a possibility of different listening experiences of the same work for the same person at different times. In other words, there is no universal musical language, and all listenings are relative. My music has always enabled relative and multiple listenings, providing great freedom to the listener. The development of new signs, which are unreferenciated from their usual framework, facilitates a new sound intelligibility, and possibly brain plasticity. The old idea of a new music for a new world works better if it is based on relativity; therefore, what I wanted to achieve in this work was to approach the problem of relativity in the most explicit way possible.

Relativity always refers to the position, and position refers to the distance, and distance to the movement: this is why talking about relativity, as in concerns the musical fact, is synonymous with talking about movement. The work is primarily a reflection on the concept of movement, which is most effectively achieved through a formalization of ideas about what movement is in music.

As we shall see, this work deals with movement and its relationship, not with meter or speed, but with the problem of variation. Here we consider motion as the difference between two given times by measuring the evolution of the material. But for this to be perceptible, it is necessary to control how memory allows for the recognition of patterns and use cognition as the variable.

Thus, this work seeks to discern the relativity of perception of musical tempos based on the different ways in which memory is related to the recognition of patterns, and therefore with the concept of variation. A person who has a good memory will perceive the work in a very different way than a person who has a short memory, but even a person with a great memory capacity may have different listening experiences according to his or her fatigue levels, which could diminish memory abilities.

Thus, this work is the result of a cognitive-parametric model that integrates the movement of material and memory so that temporality is perceived against this background. This work does not seek to recognize rhythm, time, or meter, but rather a deep sense of time; it is not about the ability to perceive a pulse, meter, or speed, but rather the sense of temporality that appears in the background of the relationship between memory and movement. Indeed, it is about the psychological experience of time, which will be relative to each person. Thus, when speaking of time, I do not talk about physical time, but rather the psychological quality of the experience of time, i.e., the time significance or the signification space of time.

We have all experienced a moment that is eternal, like a very special kiss or a situation of extreme danger, when time freezes and seems to flow slowly. Our attention is so intense over time that it seems not to flow at all. The time is quite significant and therefore the significance is very high: a second means a lot. This is the psychological significance of time. However, in other moments, time passes very quickly and we are not aware of it; when we are watching a film or focusing our attention on a sport activity, the significance of time is minimum and its signification space is little or null.

I'm certainly not the first composer who has been reflected on these matters. As we shall see, Feldman and Grisey have developed profound reflections on these aspects. Feldman is the great composer of time and memory; I would go so far as to say that he is the first composer to integrate memory as a sound material in his compositional language. And Grisey is the greatest composer of movement and perception.

As we discussed earlier, Grisey demonstrated that the perception of time is inversely proportional to the perception of the material. This law specifies that if the time is not perceived, the perception of the material is higher. In relation to this work model, I argue that, paraphrasing Grisey, *when memory recognizes a slow variation of the material, the significance of time increases, and when the variation of material is recognized, the significance of the tempo decreases*. Thus, the work is based on the establishment of cognitive rules that, depending on how a given memory enables a certain type of pattern recognition, and therefore a certain type of variation, induce a certain experience of psychological tempo. The reverse is also possible, however; a certain experience of time can prevent a perception of the variations of the material altogether.

For Feldman, there is a great relationship between the form of the work and its scale; although this reflection does not exist in my work, the way that the difference between scale and form is determined by the length of a work in Feldman’s music (which is his justification for writing long works) is identical to how the experience of the tempo is determined by the relationship between the variation of material and memory in my own piece.

> ‘Up to one hour you think about form, but after an hour and a half about its scale.’ Form is easy, it is just the division of things into parts, whereas scale is another matter, you have to have control of the piece; It requires a heightened kind of concentration. Before, my pieces were like objects; now they're like evolving things. (Feldman, *Give my Regards to Eight Street*, p. 26)[54]

For me, Feldman’s reflections and conceptions about tempo and time are the most innovative and influential of the twentieth century. He is also the first composer to relate the material variation with time and highlight the importance of memory in these processes:

> What is variation? One thing stays the same, other things change. And the slow rate of change in terms of the useful materials is equivalent to the slow rate of change to the metric structure. (Feldman, *Feldman in Middelburg*, p.222).
>
> So the function of memory was very, very important, and also the function of memory in relation to musical forms was very, very, important. (…) I began to rethink memory, and it´s very apropos the violin concerto. Because I finished reading the book [55] at that time, I was very impressed with the book, and it was the beginning of my long pieces. (Feldman, *Feldman in Middelburg*, p.474)

Indeed, the refinement of Feldman’s ideas in regard to models that relate to other musical aspects over time becomes incredible:

> There is a direct relationship between the meter and the instruments that are playing. (…) Each image seems to have its own meter and these images come back again and again. (Feldman, *Feldman in Middelburg*, p.406)

Thus, the work is based on a model of a perceptual system that integrates the cognitive rules established by Grisey and Feldman.
So, I began by trying to philosophically deconstruct the concept of relativity in the more abstract way without relating it to any field of specific knowledge. From here, I developed a formal model for modeling any relativistic theory (chapter 4 of the book). This model aims to

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[54] Feldman M., *Give my Regards to Eight Street - Collected Writings of Morton Feldman*, edited by Friedman, Zimmermam, and Monk. (Cambridge: Exact Change, 2000).

[55] The book that Feldman was referring to is French A. Yates, *The Art of Memory* (London, 1966).

establish the formal conditions that must comply with a theory, as formalized through this model, to be considered as relativist. I then defined relativity, applied it to the movement in music, and checked to see if it met the formal requirements. It was through this process that I discovered music that did not have any central parameter. Indeed, to relativize something means to stop perceiving it as the center, which is what I had been doing for a long time.

I began to consider how to formalize a musical discourse that did not have any center: if a single event could set a privileged center, avoiding a center might imply at least two events, where each could act as the center of the other. This then led me to the idea of having two different but simultaneous patterns so that speech could be relatively understood from one or the other. As we have seen earlier, the problem of movement is yet another major problem in regard to relativity, so I decided that these patterns would move at different speeds, and it would be this difference in speed that would determine the value of the parameters of the sound events.

The idea of relativity is represented in my previous works because the determination flows between parameters are not given *a priori*. The position of the listener in regard to the work is what established these determination flows. Here the relativity refers, on the one hand, to a problem of the theory of knowledge: knowledge is relative because we cannot find an absolute truth, which is why my music is focused on nothingness since it is not based on anything other than the vacuum of the impossibility of a strong foundation. On the other hand, relativity refers to the problem of moral relativity, which states that there are no absolute truths, but rather that the position of an individual in his environment it what determines his ideas about social reality and ethical concepts. It also describes how social events, which are never fixed, and their cognoscibility may vary over time as the determination flows change.

In this work I have significantly surpassed my previous studies, in the sense that I have replaced the concept of a settling fact, like what puts certain element as the center, by a formal system that allows for some elements to be positioned against others and at different speeds in order to negate the need for centrality. The concept of position plays a critical role in my work since relativity is only possible when the position of two elements are considered in relation to each other. In my previous studies, the objective was to establish, through certain structures, how a given set of parameters was placed as central by turns. This has now been replaced by a formal system that allows me to determine the attributes of elements (i.e., the values of the parameters that define it) by their positioning to others. This formal system makes the concept of settling fact, as well the principle of an order that puts a centrality a-*priori* to then change it, unnecessary.

This step is possible because there are two ways of ensuring that no central parameter exists. By keeping in mind the fact that no one is more central than others from a distance (as seen in my first two studies), one way is by using a rotary strategy in which each parameter becomes central for only a period of time, in the same way that a group of people can allow each person, and not just one, to rule by taking turns. The second way, which is a bit more sophisticated, is through a formalism that allows the position of one sound event in relation to another to determine that sound event's attributes: this is exactly what I achieved in this work. Although there may not be a central parameter, there is a sense of balance between all of them. This is equivalent to a direct democracy where there is no single leader and decisions are made directly. To accomplish this aim, each event just has be part of a different reference axis that is parametrically formalized.

This led me to the basic idea that would ultimately guide this work: the Doppler effect. Imagine two objects in motion that both produce a certain sound. The pitch that each one perceives from the other depends on whether they are approaching or departing from one another, as well as the difference in their speeds. The Doppler effect thus exemplifies the best possible relationship between relativity and movement in a physical manner. In the sense that something – the pitch – is relative to the position and movement of two objects that both make sound, and that neither can be considered as central when considering the other. To achieve this end, I formalized the work in two distinct sound masses whose pitches are determined by their speed and on their position to one another. In a certain way, the work is a continuous *perpetuum mobile* that, although it is broken several times, acts as if the two objects take turns moving along a circle in opposite directions and at different speeds, sometimes approaching and other times moving away from each other.

Speed also changes in the same way, so that a constant modulation moves in a circle and eventually returns to the original tonality, i.e., to the same point. The two sound masses represent two *perpetuum mobile* interactions in which neither of them is established as a central axis with respect to the other. Each one represents one of these imaginary parametric axes. The pitches of both sound masses are also determined by their positioning of each other. This determination changes throughout the work and defines its formal structure by changing the way the variation in the mass's position concerns the other determines the values of the sound objects' parameters. This replaces the need for a form that is defined by the variation or the organization of several elements with certain differences.

The formal structure changes how the position of a mass with respect to another determines the characteristics of the sound objects, which is a synchronous interdetermination. In the odd-numbered sections, the position of the cycle of a pattern with respect to the other cycle determines their parameters. In the even-numbered sections, the way in which the position of an item determines others is dependent on its iteration, occurs inside of each pattern, and is not synchronous. Alternatively, in each odd-numbered section of the work, time is fundamental in the way in which one of the sound mass's association with an axis determines the other one's association with the other axis since the determination of one over the other is synchronous (through the phase, as we shall see). Meanwhile, in the even-numbered sections, time does not intervene in the same manner and the interdetermination between the axes is asynchronous. This is one of the many ways in which time is used as a material and plays the structural role of the formal determinant. While this is not a work in which there are alternating slow and fast tempos, there is an alternation of sections in which the determination of positions is synchronous (odd, overtime) or asynchronous (even). In fact, to avoid possible alternating tempos, I kept the same metronomic indication for the entire work, so it is very important that the director acts as a mechanical metronome.

The fourth and central section is an exception to this rule, as we will see later. The odd sections involve a growing complexity in each of their appearances in the way in which the position of an item against the other ones determines the rest of the parameters. The function of this growing complexity is to slightly vary how the position of an axis determines the other, which causes significant changes to the experiential speed of the introduction of material. The experience of time is not derived from the metronomical speed but through the ever-changing speed of the introduction of material. Memory will make possible a kind of recognition of regularities and determine whatever the listener focuses on, thus providing the psychological experience of time. If patterns are recognized, it will be significant, if not meaningless, to the listener. The psychological experience of time is in a different dimension than time that is used as a material; this separate dimension is what is achieved through temporal relativity, which is not possible in works in which the time experience and its structural use go hand in hand.

The work is a political critique of certain ways of understanding the handling of knowledge in our political reality, mediated by the belief that there is a central parameter (e.g., the economy) or a particular class whose interest is central. (See my texts on political parametric motion machinery.) In fact, supporting the belief that a point of view regarding the political reality is the central one, inevitably allows for the objectification of the rest of the entities (see my text *The Myth of Confrontation and Political Ontology*) and generates tautological processes that lead to theories that a certain element with a central function is a prophecy that fulfills itself, or that carries its own compliance. The fact that a given element is settled as central is a form of manipulation, and the deconstruction of what serves a particular class in making that certain element central always produces a release in the form of unreification of the elements objectified by the centrality and therefore an unalienation.

In summary, we can consider the work as a two-voice polyphonic texture, or, in the sense of Boulez, two voices:

> A voice is considered as a constellation of events that are due to a number of common criteria. (Boulez, *Thinking the Music Today*, p. 193)

Each one of these two voices moves at a different speed and it is the position of one in in regard to the other that determines the values of the parameters of the sound object that are part of the voices. Since any parameter can determine the others, there is no central parameter: any parameter can act as a privileged center over the other ones. This scheme represents an example of relativity in musical movement, defined by a formal system (hence the name of the work) that complies with the conditions of settling, i.e., the predicative-aggregative definition of relativistic formal systems (see chapter 4).

In this work, parameters are used as musical materials in the same way they are used in my other two earlier works. Parametric scales and parametric modulations are present but in a more abstract way since the formal structure of this work does not require the settling of the determination flows in a very precise way, as did my other two works. *So, unlike the other two works, the establishment of determination flows is free to the listener from the first moment*. What allows me this invention is the understanding of a determination of the parameters around another parameter that cannot be heard. And although there are, as we shall see, techniques borrowed from previous works, this work's emphasis is on the cognitive pattern recognition techniques that work to create parts that go recognized or unrecognized by the listener (without a real objective change in the sound material) since the listening experience is relative for each individual. The most important aspect is the cognitive tension (cognitive dissonance) developed between moments in which patterns are recognized, thus providing moments of both comfortable and uncomfortable listening. Cognitive tension is what listeners search for in this work; small changes in the material, as determined by how the two voices overlap, produce real changes in the way they are perceived. In other words – and this is the most fundamental part for me – a constant and linear change of the material produces exponential cognitive changes in the listening process. The material develops at a certain speed of the form, and it is a sense of the speed by the listener that causes changes in the material.

The problem of speed is very important to me when new musical material is introduced, as well as the issue of this emergent material's relationship to memory. Feldman was a master at this, as seen in the way in which he utilized identical variations to produce sensations of different speed in the introduction of new material, and how the speed of the variations changed depending on the material. This makes Feldman an exceptionally unique composer; in my opinion, his ability to establish multiple relations between material and time, which are experienced differently in each of his works, made him one of the two most influential composers from the second half of the twentieth century. That is why my work investigates the relationship between the speed of the introduction of new material, musical movement, and the perception of time as three elements fused together intimately. In the same way that spectral music unifies spectrum and pitch, my work is an investigation of the integration of these components (integrational models).

Thus, the work is basically a reflection on time as a basic sound material not reducible to rhythm, and its inseparable consideration with the cognition of the movement. The relationship between movement and memory is at the core of this work. When I speak of time, I do not mean just any sort of time, but rather one determined by one's own sense that differentiates physical time from musical time. As we will see later, this work employs cognitive recognition pattern techniques to create or break various forms of time perception, and memory will be responsible for establishing the relationship between the recognition of patterns and how the tempo is perceived.

Sooner or later, all composers have to face the problem of time in music; indeed, I would even say that one is not a composer until one has articulated his own idea about sound time. In my case, of course, I associated this idea with the problem of temporal relativity. But it was necessary to first have some experience prior to meeting this challenge, which cost me five years to produce a work about these reflections. The process has not been easy, since these same ideas led me to others, and new problems arose with every new idea, which was quite paralyzing. I solved them as best I could, and not always in an adequate way. Although I would have liked to spend more time on some of these problems, some of my solutions have left me uneasy, so I already have a new way in mind of approaching additional qualms.

The concept of cognitive dissonance is based on these phenomena to the extent that the sound stream is encoded through a number of regularities and the necessary kind of introduction within these regularities, which implies, in turn, several regularities in the introduction of this variety. One such way that cognitive dissonance occurs is when there are events that cannot be interpreted as the result of a variation in regularity or consistency. This is why a few cognitive dissonances occur in the music of Steve Reich since the pattern of difference in regularities is very stable. In

Nono’s music, however, we have the opposite case; the great variation in the speed of materials in the introduction gives his work an impressive cognitive density.

The work is dedicated to Lua because she left while I was working on it. Many times after her departure, I wondered why I devoted so much time to this score, time that I regret not spending with her. As the paradoxes of destiny would have it, in making a work about time and memory, I ended up whishing the time only for the sake of her memory.

Towards the problem of motion and time

I'm going to continue describing some of the concepts that can be found in the musical literature regarding movement in music, and, conversely, how I approach the concept.

The problem of movement in music is normally set around the concepts of pulse, meter, and rhythm. Pulse or pulsation is usually considered as the basic time unit of work. According to Boulez:

> Within the framework of the duration, we can start from a smaller value and multiply it until you get the largest, it can also be taken as a unit the greatest value and divide it among an odd or even number of regular parts; It is exactly the same operation but in the opposite direction (...) At the intersection of these two methods, it is worth choosing a unit likely to be subdivided; the choice of tempo is essential both in the perception of the press and the possibility of the realization of subdivisions. (Boulez, *Thinking Music Today*, p. 81, ss. 1)

However, this notion references both a basic unit of perception and the basic unit of musical organization. These can indicate the same thing, and indeed they do in rhythmically simple works, but they may not in rhythmically more complex works. The pulse is subject, in its most original conception, to all the problems of the relativity of perception. Repetitive metric structures are ordered around the pulse, and this metric is responsible for arranging a series of pulses in time cyclically, making a train of pulses in a periodic movement. Thus, in a first approximation, we find that movement is associated with the pulse and meter to the repetition of a pattern in the traditional literature. We enter here to the periodical field to find something that is repeated a certain number of pulses, i.e., something that is repeated is a pattern. In folk music, however, movement is measured by the pulse repetition frequency, not around the frequency of repetition of the pattern. All movement implies a speed, and in traditional music, the speed is associated with the number of times that the pulse is repeated rather than the pattern that repeats several pulses. So, just as movement in space is measured by the distance traveled per time unit, it is normally (but there are other ways) measured by the number of pulses per unit of time in music.

In regard to the perception of the musical tempo, there have been several attempts to classify different types of music in relation to the perception of the pulse or tempo. In musical literature, we can find a variety of rankings of types of music based on movement, including those in which the movement depends on the pulse repetition, or those in which it depends on the speed when the pattern occurs and is independent of tempo. We can say that the firsts are works that flow over time, and time speech is what allows the perception of time. There are other types of music, however, that do not have a perceptively clear pulse that goes against the tempo or that, to say it in some way, dissolve (neutralize) the perception of temporality through listening. Some music of non-Western origin is a good example, such as any music whose movement is not based on the perception of a succession of pulses per unit of time and that somehow distort the perception of the flow of time or operate in various ways, or because the music is based on the repetition of the pattern, is very static and non-repetitive, is non-static yet very repetitive, or involves the overlapping of very complex rhythmical layers.

The perception of tempo is closely associated with the experience of time and with the passing of time and its perception. The experience of the psychological present can be considered as a time window from 2 to 5 seconds which can, in exceptional circumstances, be extended to 12 seconds (*Music Cognition* Dowland, Hardwood - chapter 7). Fraisse and Woodrow claim that there is a kind of natural time march, i.e., a kind of spontaneous psychological tempo event sequence that allows the events presented to that frequency to be easier to perceive and remember. This natural tempo ranges between 1.3 and 1.7 events per second, which is equivalent to a musical tempo of 70–90 bpm. *The present temporary window is related to one's immediate memory and the number of events that can be remembered.*

> Therefore the tempo and the perception of tempo relate very closely the procedures of memory in music. (…) A composer can change the perceived March [perceived pace] not only by modifying the frequency of submission of events but also by modifying the predictability of these events. (Dowling & Harwood, *Music Cognition,* p. 182)

According to James, time filled with varied and interesting events seems to generally flow quickly (perceived march) at the moment but it flows much longer if we look back on that time span. But if the time is empty of interesting facts, it goes slow, but is understood faster in retrospect. The time window, as it is described, will be the main part of the work's integrational model. The relationship between memory and the sound objects that are part of the current window determines the perception of the variation of the sound material (which moves as a rate of change in the sound material) on one hand and induces a certain quality of the perception of psychological time on the other.

We must differentiate between three distinct phenomena: the perception of the physical tempo (pulse), the psychological quality of the perceived time (i.e., the psychological experience of time and temporality), and the time window of the current memory of the experience associated with the present (i.e., the time interval of our experience of the event in its present form). These phenomena and their various relationships with long-term memory, which allow us to compare our experience of the present with something that happened much earlier in the work, as well as the speed of material transformation, make up the basis of this work. How certain transformations of the speed of the material's introduction can influence the present time in the memory window, is, as we shall see, one of the questions investigated in this work.

We will continue discussing the myriad ways of classifying the experience of temporality and time (two entities that are sometimes not sufficiently differentiated) with respect to the four categories previously mentioned. In *Musical Poetics*, Stravinsky reflects on several forms in which a work can set its time course: some parts exist in the normal flow of time and others dissociate from it. The first flows at the normal flow of time (the ontological time, as he calls it), which is very similar to moving at the same rate as a clock. In the other form, referred to as virtual time, the degree of dissociation of the normal tempo depends on the degree of rhythmic ambiguity and contrasts. According to Stravinsky, the first flows are based on the similarity of the elements (as seen in music by Vivaldi and Bach), while the second flows emphasize the contrasts and variety (as seen in Beethoven).

A work that wants to reflect on the musical movement must delve into these two models, investigating not only movement as a pulse rate, but also the presentation of new material – on the merits of a dissolution of the perception of time – and its relationship to memory. Here, we find a concept of musical movement that is not associated with the number of pulses per unit of time, but rather with the change of musical material per unit of time. An example would be the music of Feldman, in which there is a tempo flow based on the variation of the speed of the introduction of new materials.

Grisey was the first composer to differentiate between the perceptions of rhythm from the perception of time itself. He outlines two ways of perceiving rhythm:

> En le rapportant à une pulsation exprimée, point de repère périodique. On y retrouve l´écriture rythmique de Stravinsky, de Bartók, du jazz. Chaque rythme est perçu dans son rapport qualitatif avec le mètre. b. Sans aucune pulsation-repère, nous ne parlerons plus de rythmes, mais de durées. Chaque durée est perçue quantitativement dans son rapport avec les durées précédentes et suivantes. On y retrouve l´écriture rythmique de Messiaen et de l´école sérielle. (Grisey, *Tempus ex Machine*, pp. 57–58)

He then species a cognitive rule that specifies the inverse relationship between the type of experience of time and sound material:

> Ce choque qui perturbe le déroulement linéaire du temps et qui nous est qui laisse une trace violente dans notre mémoire nous rend moins apte accepter la suite du discours musical. ***Le temps s´est contracté,*** (…) Au contraire, une suite d´événements sonores extrêmement prévisibles nous laisse une grande disponibilité de perception. Le moindre événement prend de l´importance. Cette fois de temps ***s´est dilaté***. (Grisey, *Tempus ex Machina*. p. 77)

Grisey describes two types of time: the shrunken, produced by a variety in the introduction of material, and the distended, produced by a stable material through the reverse relationship, bringing attention to another kind of phenomena.

In admiration of Grisey's innovativeness, I based this work on the idea that a motion of the material, produced by a phase between two patterns, generates a superposition of objects that can be perceived as belonging to these patterns or as new cross objects.

As an introduction of material, the material generates an objective change that, depending on the *current memory window* (individual and subjective parameter for each listener that determines the listening position, i.e., intentionality), will be recognized in one way or another as a pattern, and the perception of temporality will arise from this pattern recognition, which is something not only different from the resulting rhythms of the superposition of the two sound masses, but also from what Grisey calls time “contracted” and “dilated.” In other words, this work involves the temporary consciousness of the memory window and the passage of time perceived by that conscience.

The fundamental concept in this work in regard to the reflection of the time is the relativity of the perception of time, which is induced by a discontinuous speed of the new materials’ introduction and the reflection of the movement in a sound speech based on the relativity of time perception through the emergence of new sound materials rather than from the pulse or the repetition of patterns. It is not music over time nor against time; rather, *a piece of music makes the perception of time possible (or impossible) in a relative way according to how that memory determines the listener.* This work is about reflecting on these issues, the perception of time, and its dissolution, and the relationship between time and the memory of past and present. In addition, speed is understood as the rate at which the introduction of new materials relating to the recognition of patterns is perceived and how this rate alters the perception of time, as well as the relationship of the kind of musical material with the concepts of memory and time.

The problem of time, as the basic substance of the sound object, is to be treated as something that cannot be independent of memory or the problem of the movement and speed of material introduction. And movement, in turn, must be treated in respect to its relationship with memory and the temporality experience (integrational model) as its two facets, either as a pulse or as a frequency of introduction of new materials. In the traditional music, however, memory is never considered. (This is a dangerous claim because, in a way, classical formal thought can be considered as a reflection on memory, but it was not stated in an explicit way. Even I would admit that some of the great masters of form have, above all, contributed the most thought and solutions to the problem of long-term memory.) Here, we consider memory, time, and movement as three parameters whose unitary relationship should be taken into account since a change in one of them affects the others although some of these parameters can be neutralized). In fact, this is what happens in the classical world: neutralizing any of these parameters prevents the liatener from having to consider it at all, or at least in an explicit manner, much in the same way that spectralism considers the integration of pitches and spectrum in its integrative model. *This work investigates the consequences of the integration of movement, time, and memory as inseparable entities* whose duly formalized relations change to construct a musical discourse that lacks centrality or the need for the neutralization of parameters, in comparison to my first studies.

To accomplish this, I'm going to use the concept of phase[56] and its association with a periodic movement. As we have seen, we can consider that the metro makes a set of pulses at a certain speed in a periodic movement. All periodic movement has a phase that can be abstractly defined as the distance from the actual moment with respect to the beginning of the pattern. The phase indicates are position relative to the repetition of a pattern. For example, if we have a set of pulses at 60 bpm and we arrange it metrically into four groups so that we create a periodic cyclical movement that lasts four units, we will be at the beginning of the pattern when we are in the first quarter note, and therefore the distance to the beginning of the pattern will be zero. The second quarter note will be a fourth away from the beginning (90 degrees). If we are at the beginning of the third quarter note, we will be in the middle and therefore will be equidistant from the end and from the beginning (180 degrees). Thus, the phase allows me to locate the position of an event belonging to a periodic movement in regard to the current cycle, independent of the speed of the cycle.

For this reason, the phase has a privileged value to define an aspect of musical movement that is not determined by the speed of the set of pulses, which is the goal of the work. To generate a type of movement in music that does not depend on the pulse but instead on the speed of the introduction of materials and the way in which the memory makes it possible to recognize patterns, necessitates the abolishment of the perception of time. In this work, I try to experiment with this ambiguity in the time function.

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[56] Steve Reich was the first composer to use, in a deliberate and conscious manner, the phase as a compositional element. For me, this innovation is very important, and I think that the uses of “phase” and “out of phase” open the door to many of the compositional problems of tomorrow, even today, that we are not yet able to imagine. This amazing composer and his works have significantly influenced my music and although I use the concept of a phase different than he does, there are reflections on the experience of temporality implicit within his music that have greatly impacted much of this work. In fact, I work with “phase” and not with “out of phase”; this discernment is not trivial, as they are not equivalent (in the sense of the way in which these concepts are applied in a sound manner).

I try to achieve such ambiguity by combining moments in which the pattern's recognition is possible and other moments that, although the patterns are still present, their "out of phase" overlap makes them unrecognizable. The phase determines pattern recognition, and therefore the change speed in perceived patterns depends on the phase between patterns rather than in the introduction of new real material. The perception of temporality will thus depend on whether the repeated patterns are recognized or not. *If patterns are not recognized, the tempo will be the pulse, but if patterns are recognized, then the perception of time shall be suspended, and the tempo of the pulse will be replaced by the periodic movement of the pattern.* Memory will be an essential factor in this pattern recognition cycle of comings and goings; indeed, the work intends to demonstrate that the actual speed of the music does not depend on the pulse nor the pattern recognition cycle. There is a kind of abstract periodic movement that is formed by the alternation of states in which patterns are recognized and others where they are not, thus producing cognitive tension and its associated cognitive dissonances. Memory plays a fundamental role since different cognitive processes that allow recognizing the repetition of events will be related to the present window memory and the memory of the past, which are both listening-related and different for each person. However, the experience of the present window size will be, in turn, determined by the speed of recognition of the new material.

Somehow, this work and its contents are based on the fundamental problem that I left unsolved in my first two studies: the problem of the time window and the memory of the material. In *Parametric Neutralizations Studies,* the temporary window frame was too broad, which requires a large memory capacity: the larger the window frame, the greater possibility of memory. The larger the frame window, the greater possibility there is in remembering, while a lower perception of tempo indicates one that is contracted. This in itself is not a problem, but it means that each new material is very stark and obvious to the listener, giving the work a very transparent formal texture. On the other hand, *Parametric Modulations Studies* has a much lower temporary window frame (around a bar) but the high density of new material prevents one's ability to recognize new patterns, and there is little formal recognition within this work.

Each of the two studies represents an opposed case regarding the relationship between temporal window, the rhythm of the introduction of new material, and recognition, in regard to memory, form, and materials. *Parametric Modulations Studies* has a more optimum window size, but its rhythm in presenting new materials was excessive. This current work tries to keep the same window size but incorporates the possibility of recognizing more patterns. Memory thus takes more prominence.

Thus, the phase is fundamental in the work, but the same phase will not be perceptible. It can determine everything without being perceived itself as a center without such centrality being perceived, just what I want. Sometimes, a listener who is familiar with the processes can come to understand, through an analytical listening, how the two voices evolve differently, but he cannot hear how the phase determines the rest of the musical parameters. The harmonics that are out of phase are equally indistinguishable since the ear cannot hear each harmonic with respect to another in each phase. You may be able to appreciate the difference of movement speed, but it works in a different way than Reich's music, in which, or so I think, you can see a bit more of the "out of phase-ness" between patterns than you can in this work.

However, even this concept will be challenged in the fourth section. In parts 1 and 3, the determination flow is inversed between the phase and the rest of the parameters in the section; this is the only time in the work in which the phase is determined by the rest of the parameters. The irony is that this is only used in the central section where the phase that acts as the determinative element in the rest of the work is now the element to be determined by another. The fourth section thus breaks the centrality of the phase even when such a structural parameter is not perceptible: the breakdown of that centrality is required. Even this centrality is broken by the end of the section, which is necessary for the existence of a section where nothing determines anything. This function is carried out by the central forth section in which no parameter determines another. As we have seen in chapter 4, to be truly a relativistic work, any element must be able to work as a perpetual center.

To achieve these objectives, I use two patterns (i.e., voices in the sense of Boulez, or reference axes) that evolve independently from one another in time. The relative phase of each of them with respect to the other will determine the parameters of each note (except at the moments in which determination flows are inversed; see section 4) or in even-numbered sections. To make this process easier and to make the formalization possible, I have resorted to a formal scheme in which each note is considered as an event that has several properties. Thus, the attributes (in the sense of predicates; see chapter 2) of pitch, timbre, the beginning and end of the note, and dynamics will be determined by the phase of one pattern with respect to the other.

Thus, the way that I utilize the phase between patterns is very different than Reich's approach. In *Piano Phases* or *Phase Patterns*, for example, Reich starts with a single pattern that is repeated in several voices and it is this same pattern that overlaps itself with a phase shift. Reich was already a pioneer in loop experimentation and phase shifting in the 1960s. The difference between what Reich and I do is that I work with dynamic patterns to be amended with regard to the phase with another pattern, while Reich repeats one or more unchanged patterns that are out of phase (loops). The "out of phase-ness" is not between patterns with respect to itself, but also between different patterns. The influence of Reich's musis in this work is very important, along with the music and theories of Grisey, Feldman, and Xenakis.

> The first part of the tape piece It's Gonna Rain, completed in January 1965, is a literal embodiment of this process. Two loops are lined up in unison and then gradually move completely out of phase with each other, and then back into unison. The experience of that musical process is, above all else, impersonal; *it* just goes *its* way. Another aspect is its precision; there is nothing left to chance whatsoever. Once the process has been set up it inexorably works itself out. (Reich, *Writings on Music*, p. 20)

Unlike Reich, the phase changes the rest of the parameters in my music in a mobile manner, developing incrementally throughout the work so that there are many ways of interrelating the various parameters. Besides, I do not seek a system that releases a determinism; I desire an open system that can constantly control and modify the functionalities that vary.

The phase between two periodic movements determines the musical parameters, but as a parameter, it is hardly perceptible. However, two patterns that are sufficiently ambiguous in respect to each other will be used to further avoid the perception of the phase, if possible. The global movement of the work is based on the phase determining more and more events over time and in the most unpredictable way. The introduction of new material within each section is always associated to the different ways in which the phase can determine the rest of the parameters. The work is a succession of separate, albeit related, sections. The process of introducing changes in regard to what the phase will determine is only relative to each section. The work is a succession of studies in which I experiment, on at a time, on one or more ways for the phase to determine the musical events. Finally, as part of this process, I create a virtual cycle against which the phase of patterns is produced. The phase of one pattern with respect to the other will no longer determine the parameters; instead, the phase relative to this virtual cycle, which is like a third voice that is completely silent and can never be perceived, will act as the determiner. As I have said previously, the work is based on the idea of the Doppler effect precisely because of this technique, but I hide it by avoiding the glissandos. Only the very forward, glissandos are associated with the phase, as seen in the fifth section. This is possible and desirable because it is only once the process is working, that one can begin to prepare its obvious origin as a new form of variation of continuous determination. This is seen in section 2 when there are a few small glissandos that do not obey the process of the phase since the determination is asynchronous in this section.

The phase is chosen as the more important element in the parameter because it is associated with time but is not duration itself, and it is also undetectable. This gives us an overall index of the relative position to the current cycle but not the work as a whole. The phase is not itself an attribute of sound objects, but its use as a material (as introduced by Reich, the first composer to use the phase as sound material) allows a great abstraction. Reich's use of phasing is just a bit more noticeable than my own.

As I said, the work is made up of two voices or sound masses, each one representing a reference axis. The two reference axes move at a different speed. Each one of these masses is also defined around a pattern. The length of the pattern is different for each mass, and the difference in length of the patterns determines the speed difference between them. Thus, the difference in speed makes patterns go out of phase. Through a few applications or functions and defined in the formal model of the structure, this phase is used to determine the sound attributes of the events that form part of each of the two reference axes. Reference axes are not defined by the four dimensions of space-time, but by the parameterization of the sound objects; instead of using the light as a metaparameter, a phase is used to define an event simultaneously from each one of the reference axes. The phase thus symbolically replaces the speed of light. Each one of the reference axes of the patterns symbolically replaces each one of the reference axes of space-time, and the applications that determine how the phase determines the quality of the sound objects replace the Lorentz formula, but this is only some sort of quote. The real isomorphism is the Doppler effect, where each one of the reference axes represents a sound object moving at one certain speed to relation to the other, and whose interaction (phase) modifies its sound attributes, thus altering how each of them listens to the other.

Therefore, the work is based on a very free, unorthodox, and hardly isomorphic interpretation of the Doppler effect; when two patterns move at different speeds, walking away from or closer to the other, the way in which one perceives the other is determined by the position between them.

Structure of the work

The work is organized around seven sections. In the odd-numbered sections, the phase between two periodic movements synchronously determines all musical parameters. In the even-numbered sections, the way in which the phase determines the rest of the parameters is less strict, less deterministic, and non-synchronous. The form consists of the oscillation of moments in which the phase is a rigid determinant, to moments in which the phase is not as strict as a determinant. Therefore, there is not an alternation between fast and slow movements; rather, there are moments in which the material is rigidly determined by the phase and other moments that are not as rigid in their determination. The changes in which parameters are related produce the formal contrasts. For this reason, the parameters are formally organized as an element of the structural organization. The formal contrast is generated by the different ways that certain parameters are determined with respect to others; that is why we consider this music cognitive-parametric.

The choice of the simultaneity of two periodic movements was made to allow a phase. It was also chosen because each of the two patterns or periodic movements makes a reference axis in regard to the other one, permitting either of them to act as central; this is similar to how an object has a reference system for determining how all the other objects. We can easily imagine two people who are standing side by side, but each one looks to the front in a distinct manner. Each will think that it is on the left (or right), but they will always think that both are on the same side. How it is possible that the two of them think that they are on the same side? Both are right, without a doubt. This is because each of them creates his own reference system. Relativity tells us that neither of the two systems of reference is absolute and that, therefore, there are no reference systems whose positions are absolute. However, it is easy to convert the coordinates of one reference axis to the coordinates of another reference axis in each reference system. This conversion is performed by certain applications, i.e., a set of formal and logical operations that convert the coordinates of one system into coordinates of the other.

Thus, each one of these two periodical patterns creates its own reference system[57] in relation to the references of the other system's pattern. Its position (out of phase) with respect to the other pattern will determine the value of the parameters of each of its musical events.

Each of the two patterns moves at a different speed that is determined by their duration. Each repetition of the pattern is considered to be an iteration of its algorithmic treatment effects. Each of the notes belonging to one of the patterns is regarded as an event with several properties (parameters) that will be modified according to the phase of the beginning of the pattern with respect to the other pattern.

To establish how each pattern varies its musical events, a set of applications is created; in other words, each part of a section is precisely defined by a concrete implementation type.

Thus, we can define the work as a formal system implemented by two sets of reference axes, one for each pattern: a set of notes (such as *e* events) belonging to the *A* Pattern A nd another set belonging to *B*. A set of applications then modifies the values of the events of a pattern in relation to the phase with respect to the other pattern. Two patterns are chosen so that each one has an independent coordinate system that is the correlative of the other through such applications. Neither pattern can be considered central in regard to the other, which demonstrates (without going into intricacies) the work's compliance with the requirement laid out in chapter 4 to accomplish the relative formalism, i.e., that the applications have an inverse, musically speaking. This means that both of the following statements are true: (1) the notes of the Pattern A are determined by *B* and (2) that the notes of *B* are determined by *A:* neither is central with respect to the other.

There are two ways of understanding the phase: as accumulated (whenever there is an iteration the previous value is stored and added to the current phase) and current (only the phase is taken in the current iteration). The former allows for smoother and more predictable changes (and, therefore, a better cognition of the process), which is why it was chosen for the beginning of the work.

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[57] To see this more clearly, see chapter 4 and the end of this article.

Each note is a musical event defined by five parameters **{**pitch, time of beginning, time of the end, dynamic, timbre**}**. Each of these events is part of a reference system relative to its pattern, and the value of the parameters of this event is calculated by employing a certain application depending on the phase of the pattern with respect to the other pattern.

To understand this in a more precise way, see chapter 4. A listing of all applications used in the work, as well as the formalism I employed, are listed at the end of the analysis.

Each odd-numbered section is divided into four parts (or phrases). Section 4 has three parts so that the second can be settled as the symmetrical axis of the work. Sections 2 and 6 have a generative structure around four patterns.

The work, as a whole, may be read in two ways: as a mirror or as a rondeau, due to the ambiguity of section 6. If we interpret 6 as an inversion of section 2, then it is a mirror (inversed B material). But if we interpret it as new material, it will be labeled as a material *D* and therefore understood as a rondeau. It can also be considered a semi-rondeau if the odd sections are interpreted as sections of *A* material derived from synchronous materials definition, sections 2 and 6 are seen as the sections of material derived from a transformation of *B* non-synchronous and generative patterns (i.e., a kind of rondeau within the rondeau), and section 4 is considered as *C* material. Section 6 is very ambiguous, so it can be interpreted as a reversal of the 2 (*B* material) or as a new material *D.*

Thus, the work as a whole has a mirror structure where part c2 is the center of the work and represents the tautological moment, as explained at the time. As you can see below, it is a mirror only to a certain extent; the work has two forces that run through it, and only one follows the logic of a mirror. But there is another logic that is even more important: the linear structure. This structure is what complicates the process in which the parameters are determined by the phase in each part.

In the odd-numbered sections, as well as between each part, there is a rotating set of modulations between instrument distributions. To prevent each pattern from associating with certain instruments, it is necessary to change the membership of the instruments to each pattern. Thus, each part rotates and changes by always using an instrument that, at the very least, does not change its pattern to facilitate the transition (modulation) of instrument distribution between patterns. Here, the term modulation does not imply a strong parametric modulation, as it did in the other two studies. But we can still invoke the use of the term here if we consider it as a modulation between scales of instrument distributions.

Formal scheme of the work

<table>
<tr><td colspan="4">Section 1</td><td colspan="4">Section 2</td><td colspan="4">Section 3</td><td colspan="3">Section 4</td></tr>
<tr><td colspan="4">A1</td><td colspan="4">B1</td><td colspan="4">A2</td><td colspan="3">C</td></tr>
<tr><td>a1</td><td>(a1)’</td><td>a2</td><td>(a2)’</td><td>BA</td><td>BB</td><td>BA</td><td>BC</td><td>a3</td><td>a4</td><td>$(a4)^{-1}$</td><td>(a3)’</td><td>c1</td><td>c2</td><td>(c1)’</td></tr>
</table>

<table>
<tr><td colspan="4">Section 5</td><td colspan="4">Section 6</td><td colspan="4">Section 7</td></tr>
<tr><td colspan="4">A3</td><td colspan="4">$(B1)^{-1}$</td><td colspan="4">A4</td></tr>
<tr><td>(a1)”</td><td>((a1)”)`</td><td>a5</td><td>(a5)’</td><td>BC</td><td>BA</td><td>BB</td><td>BA</td><td>(a3)”</td><td>((a5)’)’</td><td>((a5)’)”</td><td>((a3)”)’</td></tr>
</table>

First section

Here, we have two sound masses moving at different speeds, each one associated with a pattern. The phase of one with respect to the other determines the value of the parameters of the events that are part of each mass.

In this first section, the dynamics are fixed or neutralized. The pitches of Pattern A are neutralized in the first two sentences. In the first pattern*, A* is fixed: this is the slower pattern. This pitch is *E*. The pitches of the other pattern start with *E* but change by a demiflat every 120 degrees out of phase. The timbre is free, but it is not neutralized. Durations are also determined by the out of phase. Each *x* iteration, the instruments of each Pattern A re exchanged, producing a modulation of distribution of *instrument-patterns* to another distribution of *instrument-patterns*. These modulations are carried out using an instrument that belongs to the same pattern in both distributions as a common element; in other words, there is an instrument that does not change the distribution of instruments-patterns and is instead used for modulating. The change of a distribution pattern to another always represents the change of a part of each section elsewhere. Pattern A lasts twelve quarter notes, while Pattern B lasts 8 quarter notes. Thus, in each iteration of *B*, the phase increases by two quarter notes that are relative to the Pattern A at 120 degrees (30 degrees by eighth note).

Each repetition of a pattern is considered an iteration because the value of the parameter events is determined by an iterative algorithm in which the iteration unit is the repetition of the pattern, i.e., the iteration of the pattern. Intuitively, for those who do not want to dwell in the world of the algorithms, an iteration is a repeat. I will try to avoid algorithmic explanations and instead present everything using as much musically oriented terminology as possible; only at the end will I provide the formal description of the algorithms.

Each pattern is defined by a set of notes that can be used; the lowest of these is the base note. This structure of notes of both patterns (what I call the note scheme), some of which can be elided in the score, is formed by the set of notes that can be used in patterns generated from the base note.

For those who want or need a more in-depth explanation of the concept of phase, I recommend reading chapter 2 of Juan G. Roederer's *The Physics and Psychophysics of Music.*

First part

The instruments are distributed over two patterns: Pattern A (percussion, piano, and double bass) and Pattern B (string quartet).

In Pattern A , pitch is always neutralized on an *E*, and consists of a cycle of six quarter notes: four quarter notes on an *E* and a half note silence. Pattern B consists of a cycle of 4 quarter notes. If the first pattern is considered as a cycle that starts out at 0 degrees and ends at 360 degrees, the second pattern functions in respect to the previous 240 degrees (4 quarter notes); therefore, whenever the second pattern is repeated, there is an out of phase period of 120 degrees between the two. Every 120 degrees of the out of phase period that is accumulated with respect to the first pattern determines that the silence of the *B* pattern note lasts one eighth note more (and, therefore, the note an eighth note less) and is lower in pitch by a quarter tone. The second pattern begins 60 degrees out of phase (i.e., the duration of both patterns is centered on an axis). The next time it appears, the phase will be 120 degrees.

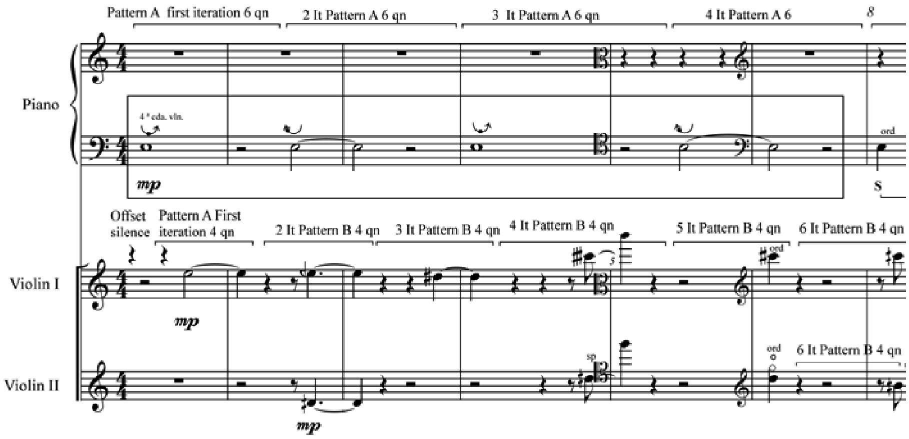
The octavation of the pitches, as well as the number of notes that can be used (up to three notes can be elided), are free. The first appearance of the first pattern is an exception to this rule, allowing the duplication of a note (*E*). The original cluster is composed of four notes by semitones from *D*: *D*, *D sharp, E*, and *F*; however, the first chord begins with *E* (the bass note is elided). The function of the elision of the base note is to create a non-differentiation of the two patterns in the first gesture at the start of the work. That non-differentiation is structural to ensure that pitches do not give information about the pattern; in other words, that they act neutral.

The first pattern is repeated always with the same duration of six quarter notes, the pitches are fixed, and only the timbre changes in a free manner.

During this first part, Pattern A is repeated (iterated) five times and *B* six times.

I should clarify the difference between the phase and the cumulative phase. The phase means that the position of one to the other determines the parameters. The cumulative phase refers to the value used to calculate the parameters and obtained by adding all former phases.

Let me break this process down even further:



The early iterations of the patterns at the beginning of the work.

The work begins with the first iteration of pattern *B*, which consists of a whole note and a half-note rest, totaling twelve eighth notes. Pattern A returns to iterate without any of its parameters modified. The *B* pattern begins in the second quarter note of the work but because the Pattern B begins with a quarter note of silence followed by three quarter notes, the first note of Pattern B does not begin on the base note *D* (elided), but on *E*. Due to the cumulative phase of 120 degrees, the base note of the second iteration is *D demisharp*, and the next is *E demiflat*. While the notes of the note scheme go by a demisharp higher at each iteration, the two notes used are in fact lower than in the first iteration. The function of having a note scheme per iteration that consists of a set of notes that can be used (or not used) through its elision is so that the listener avoids a kind of upward march, but without the march actually ceasing to exist. It is a way of preparing small cognitive dissonances in the very beginning of the work.

Until the third quarter note, Pattern B begins with a phase of 60 degrees with *A*. The algorithm used to calculate the cumulative phase is by adding 60 to neutralize the phase from the beginning.

The following demonstrates how to formalize this algorithm[58] in pseudo-code:

```
Assign i=1
Assign iterations=6
Assign n=iterations
Creatematrix Outofphase(n)
Creatematrix GradesrunbyA(n)
Creatematrix GradesrunbyB(n)
Repeat up to i=n
        If i=1 Assign Outofphase(1)=0
        Assign Outofphase(i) = GradesrunbyA(i) - GradesrunbyB(i) + 60 + Outofphase(i-1)
Next  i
```

In the first iteration, the phase is zero by definition. The second would be (360 - 300) + 60 = 120. The third would be (720 - 540) + 60 = 240, etc.

Thus, the basis of the application, which is used in the first part of the work, has the following functions. First, it allows a slight perception of the phase and a constant increase of the pitch in the first few bars, as this is the section of the work with the most simplicity when the listener would begin to discern the logic. As the piece develops, parameters begin to interact with each other in more complex ways. The dynamics do not play a role, as it is a neutralized parameter; this is a symbolic inversion to the first two studies in which dynamics did play an important role. Indeed, there are many instances of inversion between this work and the previous two; in this work, for example, formalism begins the piece without using dynamics, despite it being the most obvious parameter to use. The fact that the two patterns are centered on a symmetry axis but not at the same time allows and facilitates the initial recognition of the patterns' difference in speed in the first three iterations. The function of a slight timbral change and the decrease of notes in Pattern B is to break the logic that allows the listener to recognize the overlap and phase of both patterns. The first ambiguities and very light cognitive dissonances arise in the same manner. This way, the weak cognitive dissonances are already prepared and anticipated in a context of predictability so that they can be utilized in a stronger manner later in the work. In this first part of the work, there is a correlation (not isomorphic) with the theory of relativity since pattern *B*'s notes tend to be shorter depending on the increase of the cumulative phase in the same way that objects are shortened as they approach the speed of light in the theory of relativity.

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[58] For musicians who are not familiar with the pseudo code, I recommend chapter 1 of Reck Miranda's *Computer Sound Design*. For non-musicians, I recommend chapter 1 of Brassard and Bartley's *Fundamentals of Algorithms.*

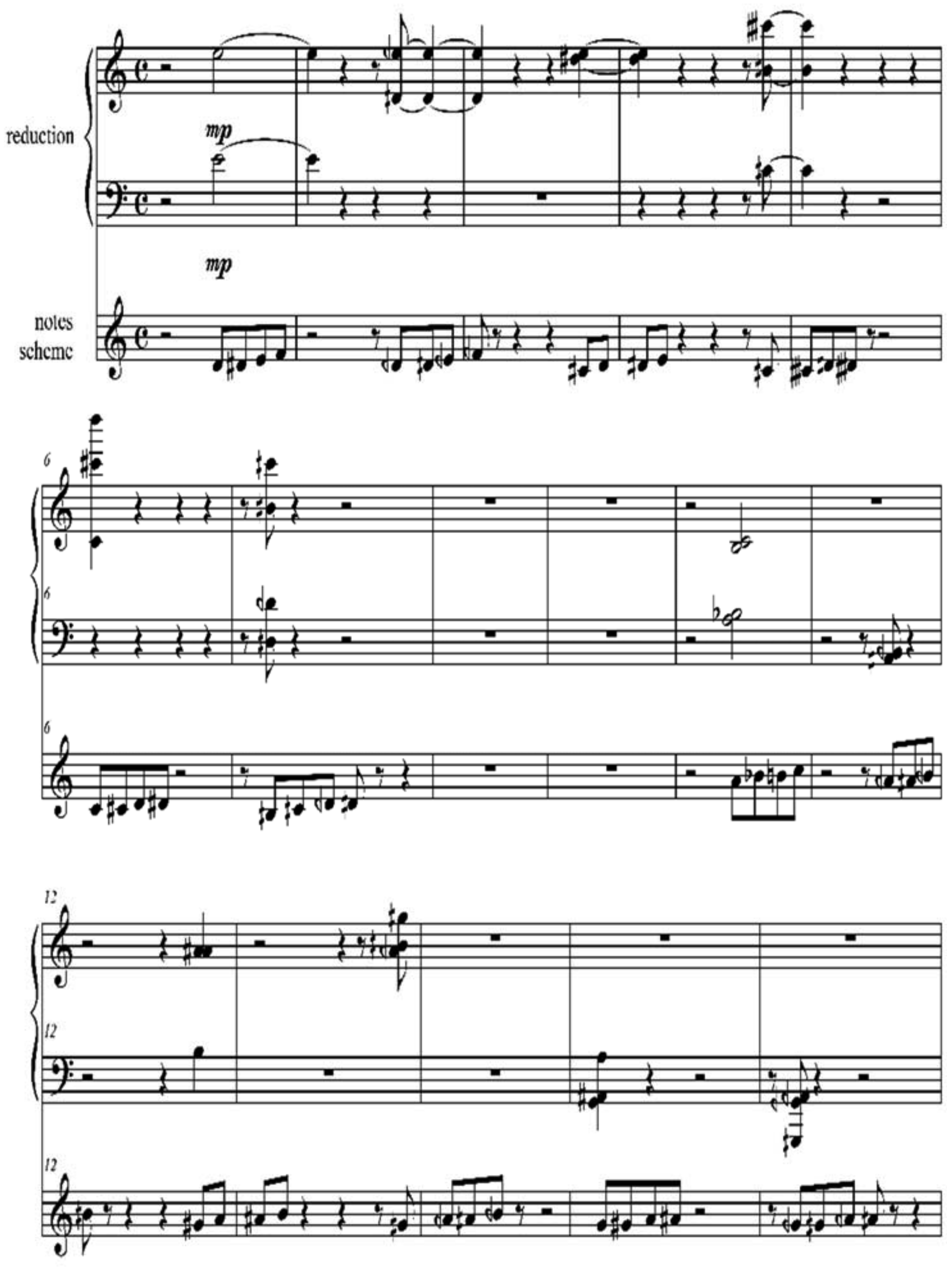
Second part

The new distribution of instruments-patterns is: Pattern A (vl1, pno, vla) Pattern B (perc, vl2, vcl and cb).

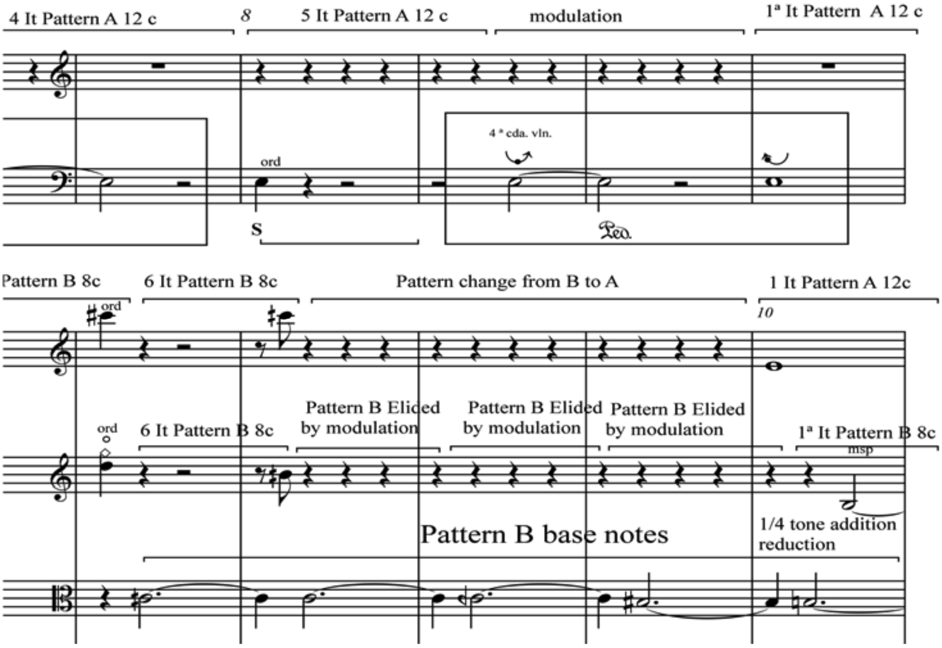
The piano is used as a common modulator element between both instruments-distributions because it follows the same pattern in the two distributions. Pattern A is repeated in bar 8, eliding the other two instruments. The duration of Pattern B is reset to 3 quarter notes, but notes' pitches continue descending from the previous appearance of the pattern. The repetition of Pattern B is elided twice during the modulation, but the account of the phase is still active; therefore, notes reappear at a lower pitch. In addition, they are artificially lowered to another semitone to bring the two patterns together: the base note with *A*.

During this second cycle, Pattern A repeats five times and *B* six times.

At each occurrence of pattern *B*, the note scheme is lowered by a quarter tone. In bar 17, the *A demiflat* in the cello is repeated because it is the instrument that does not change its pattern in the following sentence. In each modulation of instrument-distribution, the one that does not change its pattern is always chosen as a modulating instrument, and the instrument is different every time.



Distribution of durations and notes of Pattern B in parts 1 and 2 of the first section.



C= eighth note

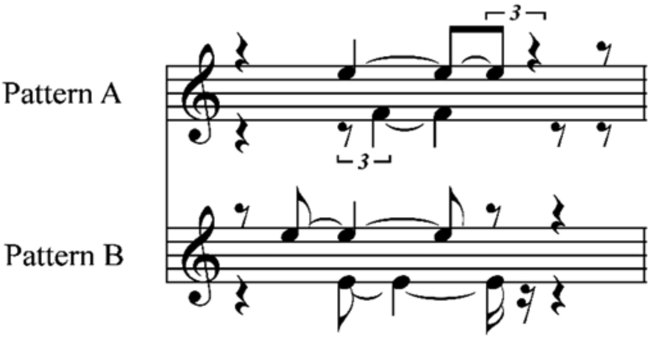
Modulation between the first two parts of the first section.

We will slowly see the modulation scheme. In bar 8, Pattern A makes its fifth and last iteration (in *E*), ending in the second quarter note of bar 9. The piano is used to modulate and repeats itself, taking the duration of Pattern A to 12 eighth notes to the *E* the of pattern. The block of the second section begins in bar 10 and the piano again repeats the *E*, this time accompanied by a violin and viola that belong to Pattern A .

In bar 7, Pattern B performs its latest iteration on the base note *B demisharp* and ends in the first quarter note of bar 8. During the modulation, Pattern B is elided three times, but the account of the accumulated phase remains. Pattern B begins in bar 10 (with a quarter note of silence) and the base note becomes *A demisharp.* This note is artificially lowered to *A* for two purposes: (1) that each one of the first two parts of section 1 starts with *E* or *A,* which are the work's two most fundamental notes; and (2) that any instrument can use micro intervals in the first iteration of section 2 to prevent the section from beginning with strong dissonances.

Third part

The result of the superposition of the two previous patterns is now used as a base for each one of the two patterns that will be used in this next phrase. Now, each of the two patterns will have a scheme of notes that move in the opposite direction. Pattern B will continue descending and Pattern A will continue ascending to generate a contrary movement between the two of them.

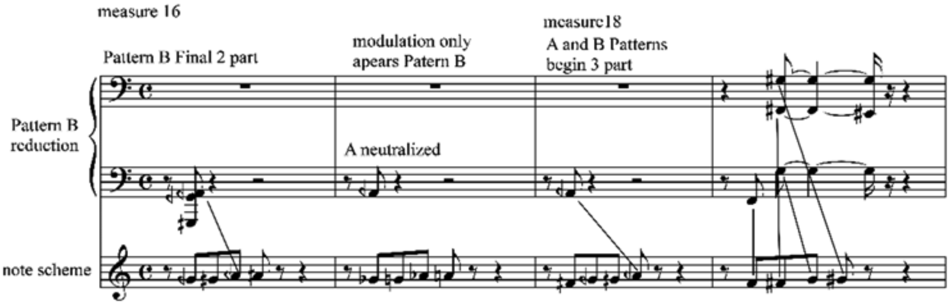


The pattern-instrument distribution is: *A* (percussion and violins) and *B* (piano and trio basso). The duration of Pattern A is reduced by half, from 12 eighth notes to 6. The proportion of the phase between the *A* and *B* patterns is inverted 4/3 to 3/4, so that Pattern A takes 3 quarter notes and *B* 4 quarter notes. Here, the durations are determined only by the pitches rather than the phase, and durations remain fixed. The cello is used as a common instrument in this distribution and the previous one for the same reasons as in earlier parts of the piece.

The function of those proceduces is to generate a kind of acceleration in the introduction of the material without anything actually being modified. It also allows the section to be split into two parts. However, not all sections are sub-divided in the same way; in fact, most will be formed by a central block and a lateral one rather than two consecutive sections.

During the cello's transition between the second and third sentence, the lowering of the pitches by a quarter tone in each out of phase period is strict so that the phase does not increase by a quarter tone like it did during the first modulation. It is literal; one exception, however, is the *B* in the cello, which is frozen during the process of transition.

In this part, Pattern A repeats nine times and Pattern B repeats seven times.

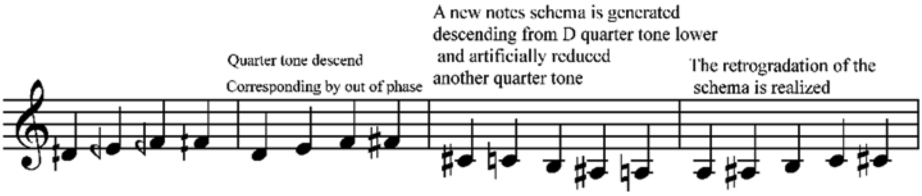


Modulation from part 2 to part 3, section 1.

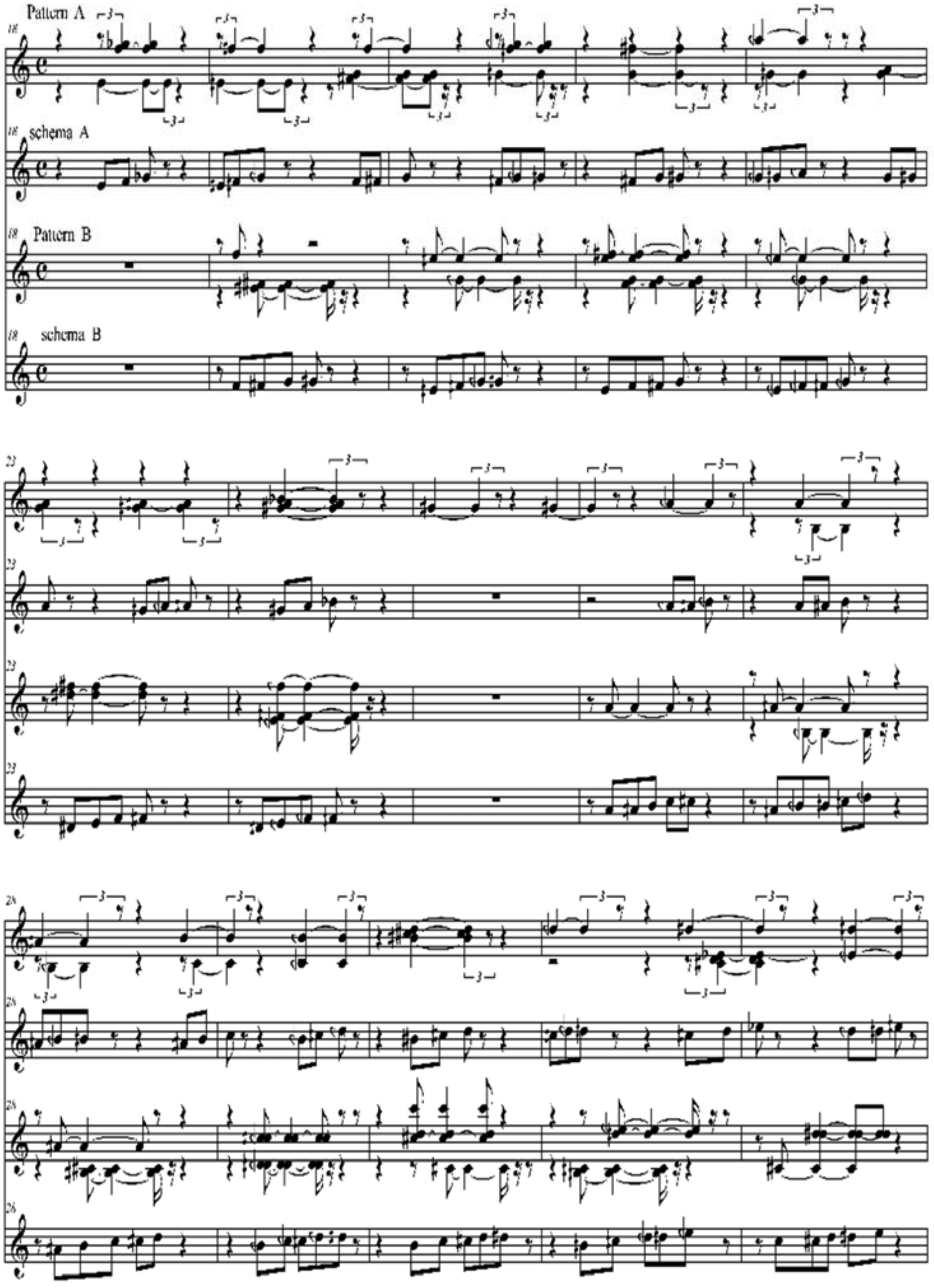
Fourth part

The pattern-instrument distribution is now: Pattern A (piano, percussion, and cello) and Pattern B (two violins, viola, and cello).

The timpani is used as the modulator instrument, so it maintains the same pattern in the current and previous distributions. The note scheme used in Pattern A follows the same logic as the preceding sentence. In this part, Pattern A repeats nine times and Pattern B seven times. However, the note scheme associated with Pattern B endures several modifications: for example, it reverses the sense of the notes of pattern *B*, i.e., a quarter tone is added in each out of phase section rather than subtracted. The number of notes in the note scheme is also expanded to five and inversed from a descending to an ascending pattern, which means that each out of phase pitch is increased by a quarter tone. Also, artificially, pitches drop by a quarter tone in modulation (it should be *D demiflat* but it is lowered by a quarter tone to make it *C sharp,* creating symmetry between the first and third modulations of this section). This note scheme is inverted in such a way that *A* (the last note) will begin the new base note. Pattern A is, in turn, suspended by the accumulated descent during the modulation to pass from *G#* to *A demiflat*. (I should be noted that if I had continued, the next section would start on *A*, but each pattern would have been ambiguous, and it would be very difficult to associate notes with patterns. This would have been nefarious for the beginning of a sentence in such an early section of the work.) I take some freedom in bar 30 during pattern *B*, making the four notes appear at the same time. This then delays the second note in bar 31 by an eighth note, which appears in the first position. By the end of the section in bar 32, the organization is free, allowing any duration to be altered.


Quarter tone descend
Corresponding by out of phase
A new notes schema is generated
descending from D quarter tone lower
and artificially reduced
another quarter tone
The retrogradation of the
schema is realized

Modulation from part 3 to part 4, section 1



Note schemes in the third and fourth parts of the first section.

Overview of the structure of the first section

The structure of the first section is divided into two parts, which are both divided into two smaller parts that are defined by the same type of material and the same number of repetitions of each pattern: five against six in the first two parts, and seven against nine in the last two parts. There are three modulations in which the first and third ones increasingly use the artificial quarter tone to indicate the central modulation.

Second section

Bars 34 to 74

The second section is a bit freer than the first. It consists of a collection of four intercalated cells, each one representing a pattern formed by two elements. The cells appear following a generative algorithm. The function of this second section is for the determinations to exist within the two elements of the cell: they form part of a Pattern A nd are not between two different patterns. This function is another way of formalizing a kind of relativity that is less dependent on time (non-synchronous) but follows the same scheme. In this second section, the number of the pattern's iteration determines the parameter instead of the position of one pattern with respect to the other, so it is asynchronous. Insofar as iterations occur over time, time to indirectly determine the parameters, the phase is not involved. Since the two elements are always present at the same time, they form part of the same pattern. Thus, instead of having two patterns, we have a single pattern with two elements, since the number of iterations is what determines the transformational process. In the even-numbered sections, each one of the pattern elements represents one of the reference axes. This maintains the idea of two voices, each one represented by each of the two elements of the pattern.

Each one of these cells has a two-part texture that changes in each iteration in the opposite manner. Once a pattern is repeated, the duration is increased by a quarter note. Another function of this section is the introduction of new materials that will be used later to anticipate and prepare these elements.

The intercalation of the four patterns (A, B, C, D) according to the generative recursive tree scheme in three levels of iteration is as follows:

ABAC	ABDC	ABAC	DBDC
AB	AC	AB	DC
A	B	A	C

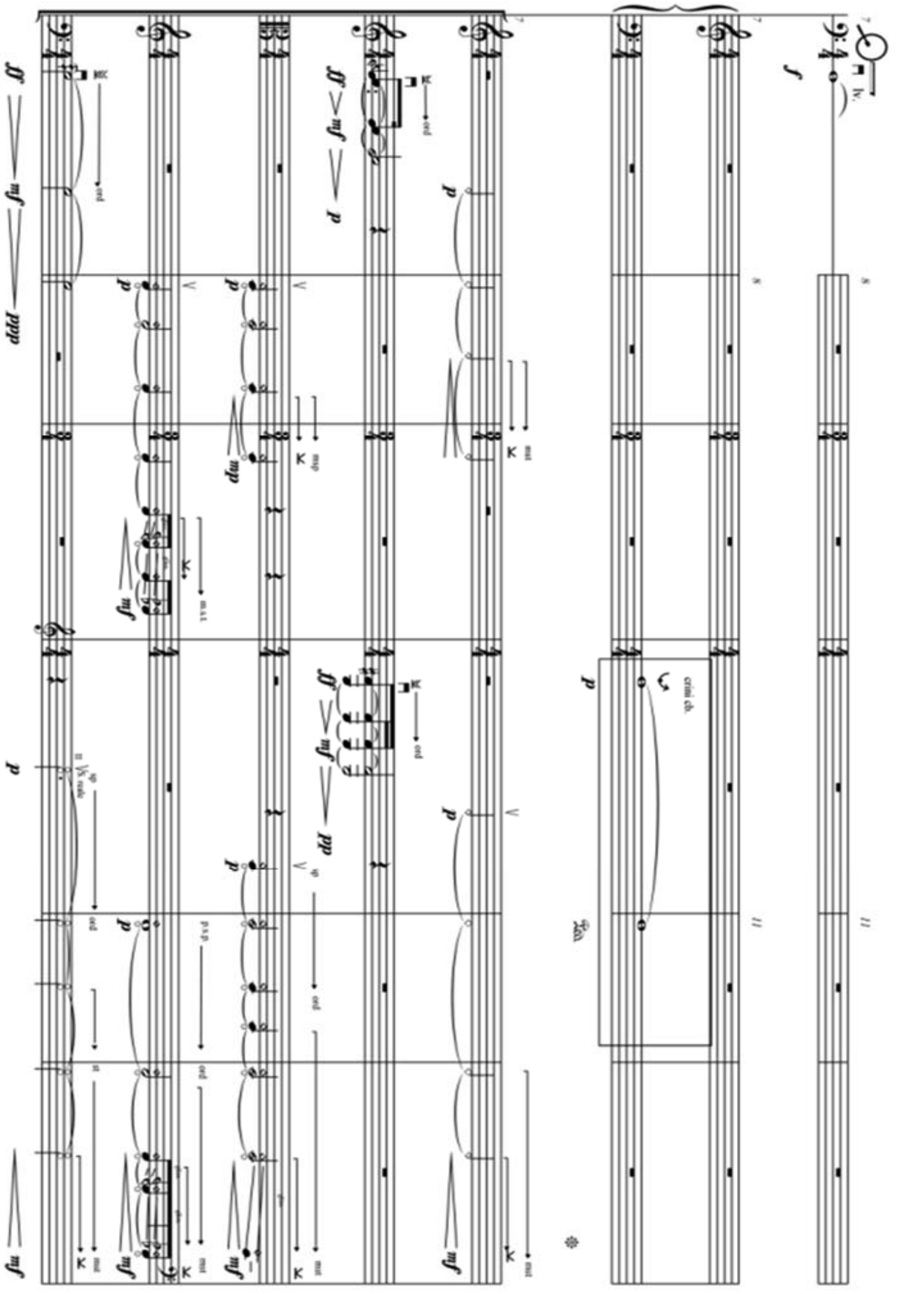
Pattern A

Cell *A* of the second section has a texture consisting of two elements: a *forte* attack that diminuendos over time and moves from an overpressure to a normal timbre; and a crescendo in harmonics, another inverse element that develops to a little harmonic pressure and a light glissando by the end.

A cross between these two textures occurs in the development of this pattern, which works to reduce the first texture and expand the second. In the first occurrence of Pattern A*,* the first textural element is present in all instruments except the piano, in the form of a bowed string. The first texture loses an instrument and the second one adds it during its subsequent iteration. In addition, the initial dynamic of the first textural element, as well as the overpressure, is quiet. The first element of the textural elements reduces its duration, while that of the second one enlarges it. From the point of view of the pitches, all notes are formed symmetrically around a central pitch that decreases by a quarter tone in each iteration; this process begins on an *A*, as heard in the double bass, and the rest of the instruments sound a note above or below this note: *A flat* in the cello, *F sharp* in violin 2, and *F* in violin 1. In the other direction, *B flat* is heard in the double bass, *B* in the cello, and so on in an upward manner. The second iteration starts with an *A demiflat*, also in the double bass, and the third iteration begins with an *A flat*. The notes in the second part of the Pattern A re all around *D,* except the piano, which is on a *B* in order to emphasize that the *A* is the generator of all pitches in this pattern.

The percussion always belongs to the element *A* (gong).

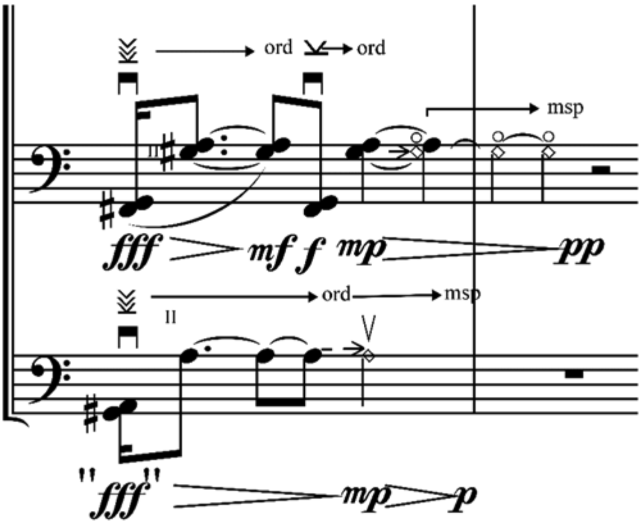
In the following two figures, we can see all iterations of the pattern together, without the intercalation of rest of the cell patterns.


l.v.
ord
mst
crini cb.
ord
pod

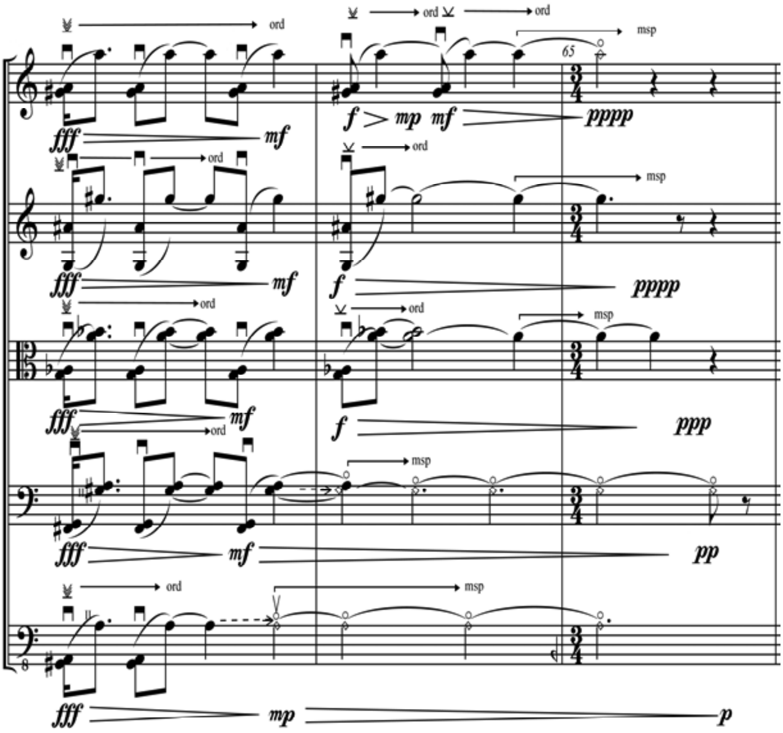
Pattern B

Pattern B consists of two elements, but one is null, completely elided, and imaginary. The other element consists of an attack in sixteenth notes with an overpressure that resolves in one or several notes approximately an octave above the first attack. This resolution moves towards harmonics. This design occurs again in each voice for a different number of times. In the first occurrence of the *B* element, this design occurs once in the double bass and twice in the cello (bar 36).

Each new occurrence of Pattern B adds a voice. For example, the viola in the second appearance increases the number of notes and the number of occurrences; thus, if the design appeared once in the double bass, it now appears twice, since events get longer over time. In the third appearance of pattern B, the number of designs is fixed in each voice, but one more design appears in each new voice than was used in the pattern's previous appearance. Percussion and piano represent the elided element: their notes are frozen and based on two clusters as generating elements of the pitches.



First iteration of Pattern B in the second section



Last iteration of Pattern B in the second section.

Pattern C

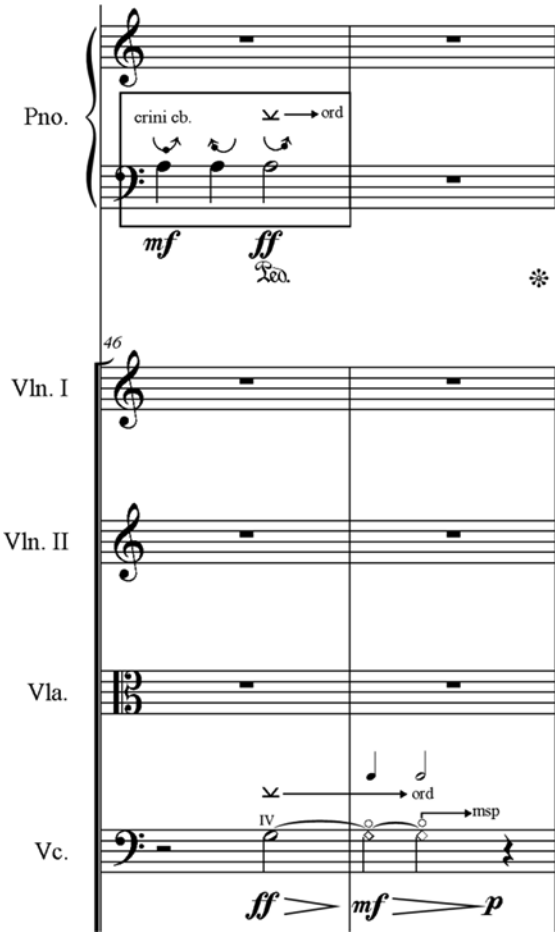
The first element, which tends to decrease, is a piano cluster whose central notes are repeated by the vibraphone. The number of repetitions of this cluster by the vibraphone is increased per iteration. In each occurrence of the repetition, there are fewer notes played by the vibraphone. The notes of the vibraphone clusters are centered on *D*. The piano cluster covers one octave from *G* to *G*, so its center is *D sharp.* Whenever this pattern is repeated, the cluster loses notes symmetrically by the extremes and dynamics are diminished, reduced one grade per iteration.

The second element is a sustained note whose timbre develops more overpressure qualities and whose dynamics increase in each iteration of the pattern. The first occurrence is *G*, which is the core of the cluster. In each new occurrence of this pattern, the piano cluster loses notes on its central note, while the number of notes related to the second element increases. The number of notes is increased by one and the number of pitches increases each time. In the pairs of iterations, notes are altered by quarter tones. In the odd-iterations, repetitions are always altered chromatically around the *G*; in the second appearance for example, the *G* in violin 2 becomes a *G demisharp*, and a new note appears as a split of *G* in the viola, which is a *G demiflat*. Likewise, with each repetition of the *B* element, the overpressure timbre becomes more acute and the dynamics are increased. This pattern is repeated four times.

Pattern D

The first element is based on a set of repetitions of an *A* with *crini. cb.* at the piano. With each repetition, the crini pressure and the duration of the notes increases. The last note always begins with the beginning of the second element, allowing both elements to demonstrate a certain pressure.

The second element consists of a cluster of up to four notes, evolving from an overpressure to harmonic timbre, with pitches always focused on *G*. In the first occurrence of the pattern, only *G* appears; the other ones are elided, but they appear little by little. In each new iteration of the pattern, the number of pitches increases and they appear as quarter of tone. This Pattern A ppears only three times and can be considered a retrogradation of the first.



First iteration of pattern D.

Third section

Bars 73 to 123

Scheme of Section 3			
A (***Pno***, perc, vl1): same as the beginning.	A (Vcl, ***pno***, cb): same as the beginning.	A (***Per***, vl1, cb): Element *A* of part *B* pattern.	A (***Per***, pno, vla): like the beginning.
B (vl2, vla, vcl, cb): element *A* of Pattern A in the second part.	B (perc, vl1 vl2, **vla**): Element *B* of Pattern A in the second part.	B (pno, vl2, **vla**, vcl): Element *B* of Pattern A in the second part.	B (vl1, vl2, vcl, cb): element *A* of Pattern A in the second part.

This section is a mirror tucked into another mirror. Parts 1 and 4 are the same in the sense that the pattern-instrument distribution is almost identical, and their patterns are completely identical. Parts 2 and 3 also form a mirror between the center of the entire section. The function of this mirror is to develop the two previous sections and anticipate the end of the first half of the work. Therefore, since the fourth part is the end of the first half of the work (the first three sections) and anticipates the final, it must be separated from the other three parts. At the same time, in so far as the first part must also be separated from the others, the first and fourth parts are also independent, which creates another mirror between the separate parts and the central mirror. This structure is defined by its marked recapitulation function.

Part 1	Part 2	Part 3	Part 4
Item A	Mirror		Item A
Mirror			

Parts 2 and 3 begin and end with two symmetrical blocks in mirror 11-12, 12-11, which begin and end in phase

First part

In the third section, the phase between the two non-simultaneous patterns once again determines the parameters and their modifications. In this section, *the phase is not cumulative* as it was in the first section because the duration of Pattern B changes per iteration, decreasing one eighth note. In the first section, the speed of the phase's increase was constant because the two patterns always maintained the same length. In this section, however, Pattern A is constant, lasting 6 quarter notes, but Pattern B begins with 8 quarter notes and decreases its duration by an eighth note per iteration. Despite their similarity, the main difference between the first and the third section, is that *the duration of patterns is not fixed in the third section,* which allows for a greater variation and unpredictability for how the phase between patterns determines other parameters. Therefore, through a procedure nearly identical to the one used in the first section, the overlapping patterns in the third section are much more irregular and unpredictable, and its cognition is more difficult and imprecise. The result is a greater perception of new material, and more unpredictable changes that are sensed by the listener in regard to the duration of the memory present window.
Pattern A consists of percussion, piano, and the first violin. It is identical to Pattern A from the beginning, except the violin has replaced the double bass. The recapitulation is also based on the integration of the pattern's instrumentation in the latter part of the first section by percussion and piano, which is presented this time by the cello. The identity of the pattern-instrument distribution from the first section is reused here.

Section 1			
A (Cb, ***pno***, perc)	*A* (Vl1, ***pno***, vla)	*A* (***Per***, vl1, vl2)	*A* (***Per***, pno, vcl)
B (vl1 vl2, vla, vcl)	*B* (perc, vl2, ***vcl*** and cb)	*B* (pno, vla, ***vcl***, cb)	*B* (vl1 vl2, vla, cb)

Section 3			
(***Pno***, perc, vl1)	(Vcl, ***pno***, cb)	(***Per***, vl1, cb)	(***Per***, pno, vla)
B (vl2, vla, vcl, cb)	*B* (perc, vl1 vl2, **vla**)	*B* (pno, vl2, **vla**, vcl)	*B* (vl1, vl2, vcl, cb)

This identity is formulated by the first modulation as carried out by an instrument of Pattern A , the second modulation by an instrument of pattern *B*, and finally by one of *A* (pno, vcl, vla, perc). To maintain the structure but avoid repeating the distributions, the instrument that is used in Pattern B to perform the modulation is the viola (section 3), replacing the cello (section 1) in the central modulation of this section.

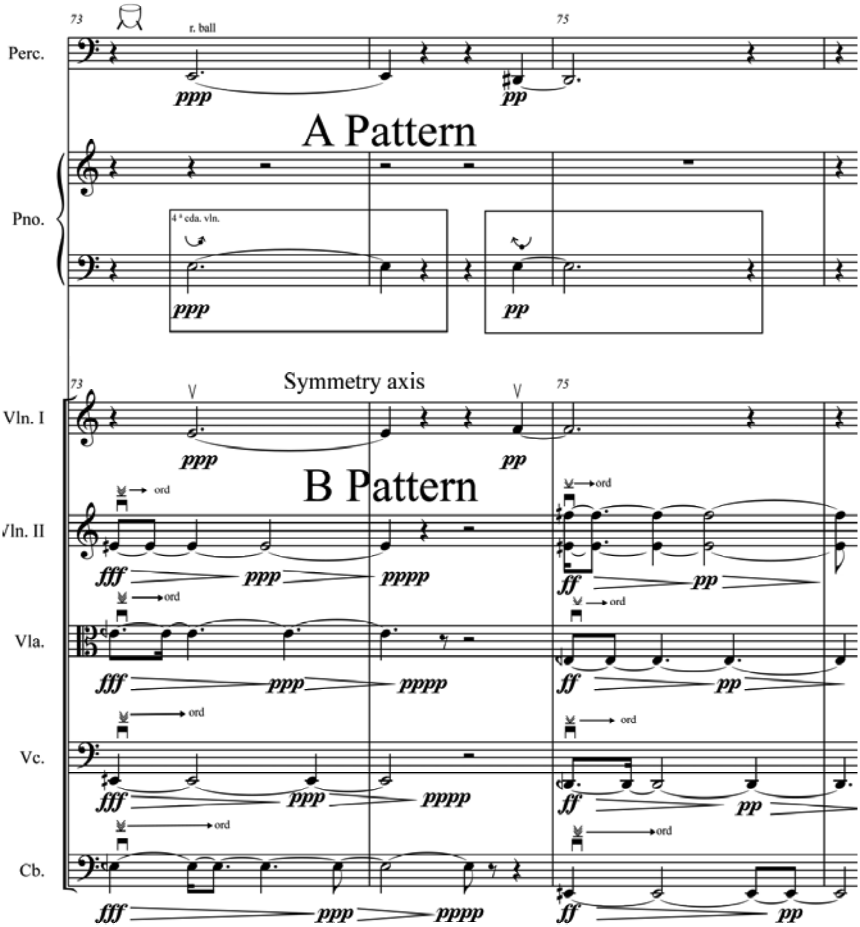
This technique generates a certain kind of recapitulation and preserves the symmetry between the two patterns. The first section begins with Pattern A *,* and pattern *B*, which is shorter, appears later, yet both are centered on an axis that corresponds to half of the other's pattern. In the third section, Pattern B begins first, this time without being centered, thus reversing the order of appearance with respect to the first section.

Unlike the first section, the dynamics are not neutralized; rather, they are defined by the number of each pattern's iteration. In Pattern A , the dynamics increase a degree per iteration. In pattern *B*, the dynamics diminish a degree with each repetition. As a consequence, there is a cross relationship similar to that in the second section of the work.

The pitches of Pattern A are the continuation of Pattern A 's pitches at the end of the first section (bar 32, double string of the cello). This signifies a close in a cycle in which the beginning of the first part of the third section is a delayed cadential resolution of the last part of the first section; although the pitches of Pattern A are neutralized in this part of the section, the resolution of the notes at the end of the section cadenciate on *D* sharp, *E,* and *F,* just like the beginning of the third section. Thus, the third section can be considered as both a continuation and a delayed resolution of the first section. Section 2 delays and interrupts this resolution.

The pitches are neutralized in Pattern A and any of them can be elided; in fact, in the first instance, only *E* appears, which is why the resolution of the end of the pattern of the first section is equal to its own reappearance in this recapitulation.

However, it is only a relative resolution since Pattern B is taken from the second section. Thus, the third section has elements of the first two: Pattern B is taken from the first element of Pattern A in the second section. This gesture is characterized by long notes that evolve from overpressure to normal timbres and decrease their dynamics. Remember that one of the functions of the even-numbered sections is to anticipate and prepare new materials of the odd-numbered sections.

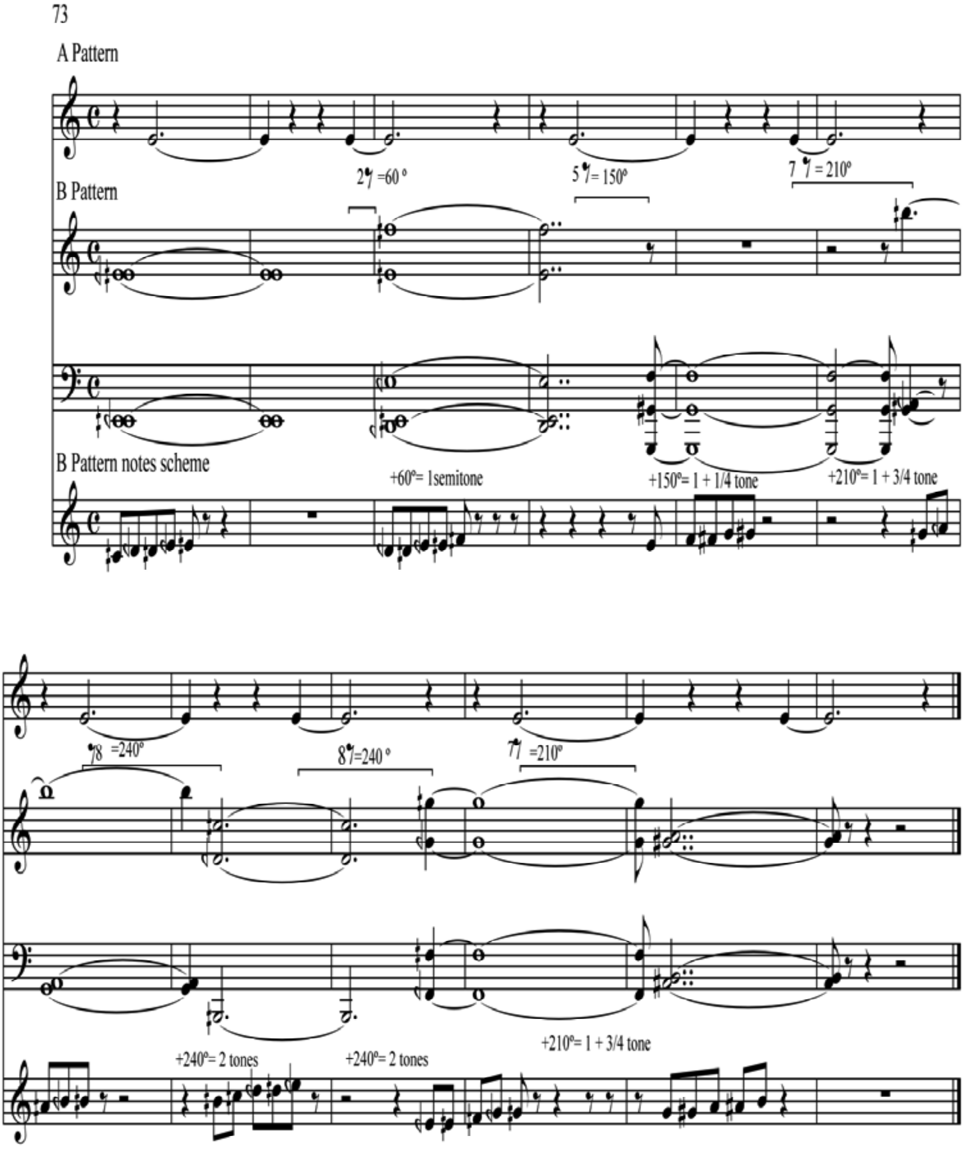


Beginning of the third section.

The out of phase determines how the notes increase in pitch in each iteration of the pattern, at a rate of one quarter tone for every 30 degrees. Pattern A begins with neutralized pitches, while Pattern B begins with *C demisharp*, *D demisharp, D demiflat,* and *E demisharp*. The out of phase is measured by the difference in eighth notes between the new entries of each iteration or the repetition of patterns. Pattern A starts its first repetition in the fourth quarter note of bar 74, and Pattern B begins its repetition at the beginning of the bar 75; here, there is a distance of two eighth notes, which indicates an out of phase measurement of 60 degrees. This degree will then be added to the notes of the first occurrence as a semitone to become *D* demiflat, *D* demisharp, *E* demisharp, and *F* demisharp.

Thus, the note scheme depends on the phase in eighth notes multiplied by a quarter tone for every 30 degrees as follows:

Note scheme from the first part:



Second part

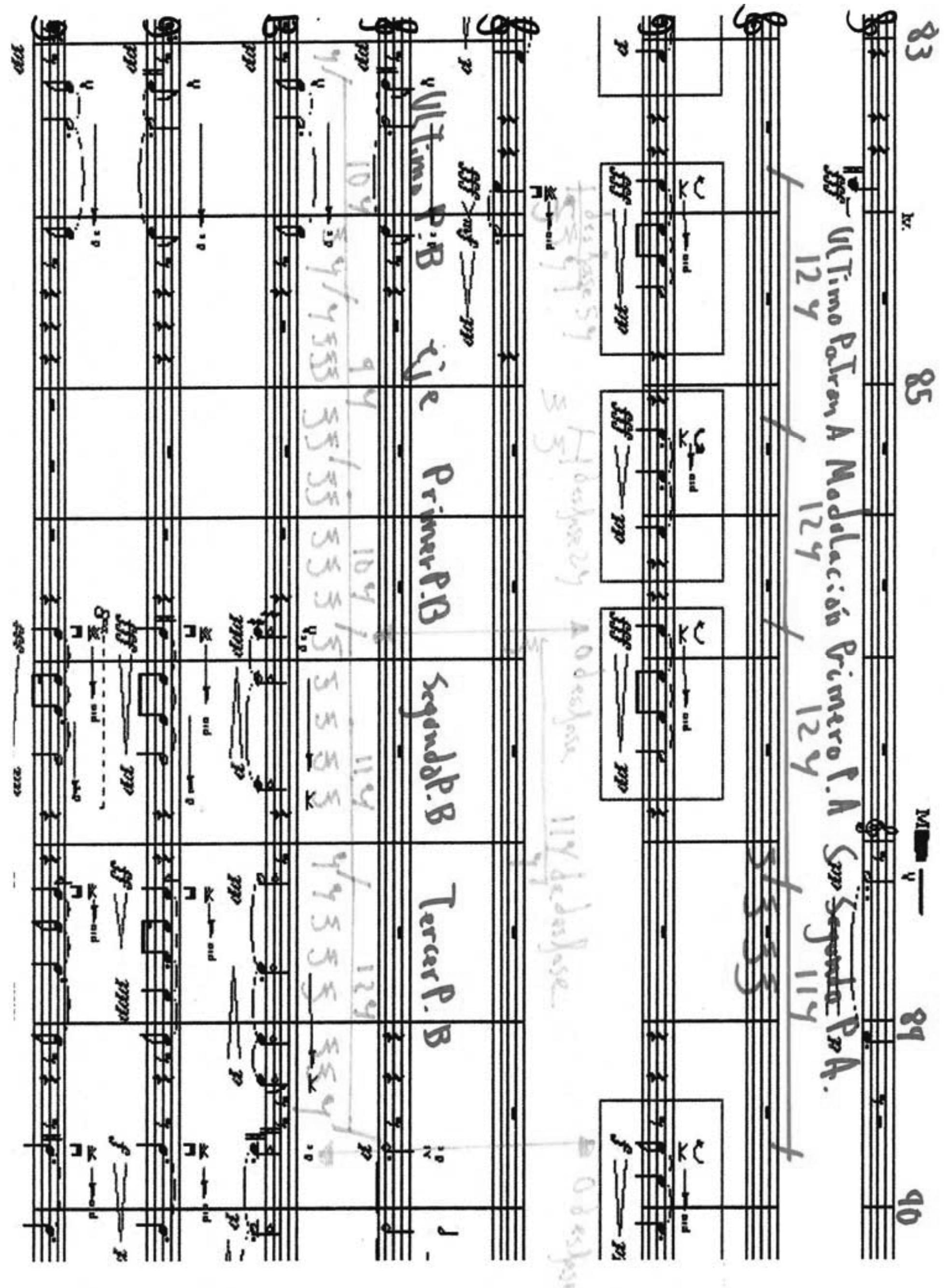
In the second part of the third section, Pattern A lasts one eighth note less each time; this is first time in the work that Pattern A has changed its duration. Pattern *B*, which lost an eighth note in part one, now gains one eighth note per iteration. Here, there is also a cross in the process of the durations of each pattern. For the first time in the piece, the two patterns change their duration: one becomes longer, and the other becomes shorter (typical crossing of the second section). This creates a symmetry between the two parts that is centered on the durations of pattern B; because Pattern A contradicts this symmetry by being fixed in one part and mobile in the other, however, the durations of Pattern B are varied. In addition, the pitches in Pattern A in the second part are no longer fixed, decreasing by a quarter tone for each repetition of the pattern (not by the out of phase space). This causes even more irregularity. The transition from regularity to irregularity is one of the factors that impact the directionality and tension of the work. This out of phase allows both patterns to match at the start of the newest iteration.

In this part, the pattern-instrument distribution is as follows: Pattern A (piano, cello, and double bass) and Pattern B (two violins, viola, and percussion).

The modulation, between the first and second part is very special, parting from a structure of fixed-mobile patterns (in which Pattern A maintains a fixed duration and Pattern B a non-fixed duration) to a mobile one (i.e., both patterns change their durations). The modulation between the pattern-instrument distribution is carried out by the piano in bar 85, repeating the same gesture associated with the latest iteration of the first part, which is equal to the first iteration of the second part. Two repetitions of Pattern B are elided, creating a pivot of symmetries. The first of these elisions of Pattern B lasts nine eighth notes (in the bar 84). The second elision is the first iteration of ten eighth notes in the second part (bar 85). The function of this strange symmetry is to match the in-phase space of both patterns (bar 86).

The symmetry of durations in Pattern B is as follows: 16, 15, 14, 13, 12, 11, 10-9-10, 11, 12, 13, 14, 15, 16.

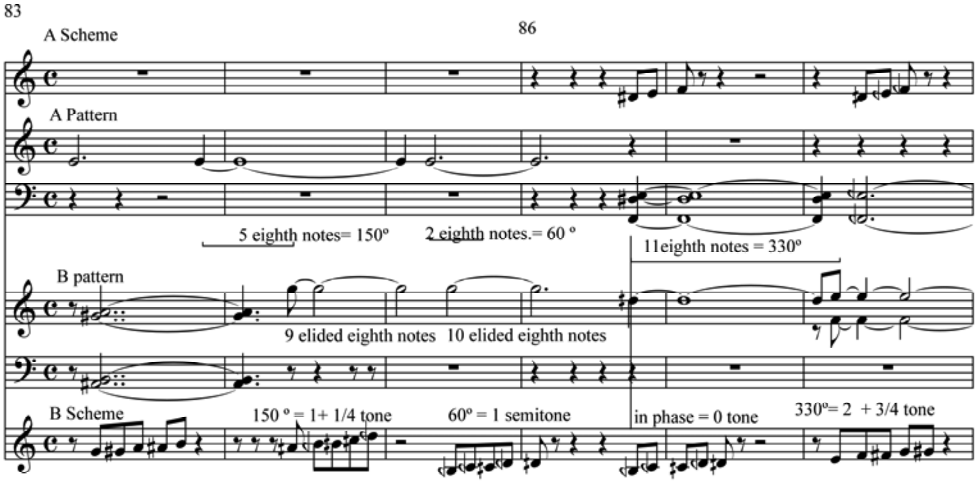
If the axis of symmetry had not been created in the ninth iteration and repeated in the tenth iteration, the coincidental in phase of both patterns would have not been possible.



Modulation from part 1 to part 2 (in color at http://busevin.art).

The modulation between the first and second part is performed through the piano since it is a common element of both pattern-instrument distributions. In order to reduce the score to only piano, pattern *B*'s iteration corresponding to the modulator axis of nine eighth notes and the first iteration of the second part are both elided. The first part ends with an iteration of ten eighth notes that remains the central iteration of the axis of symmetry between the two parts and the first iteration of ten eighth notes. This permits the two patterns to begin together and remain in phase one with another in the first entrance. Moreover, a cross between the durations of both patterns also occurs: the first iteration of Pattern A lasts twelve eighth notes and the second eleven eighth notes, and Pattern B reverses those durations (11 to 12). This all serves to define new functions in this part of the piece and settle the new determination flows. Although iterations corresponding to nine and ten eighth notes in Pattern B are elided, it is important to remember that the out of phase duration continues to happen per iteration. Therefore, both iterations accumulate an out of phase duration of seven eighth notes: five in the first iteration and two in the second. Hence, the first *B* Pattern A ppears, with respect to the last of the first section, by increasing pitches by this out of phase duration (1 tone and 3/4 of tone).

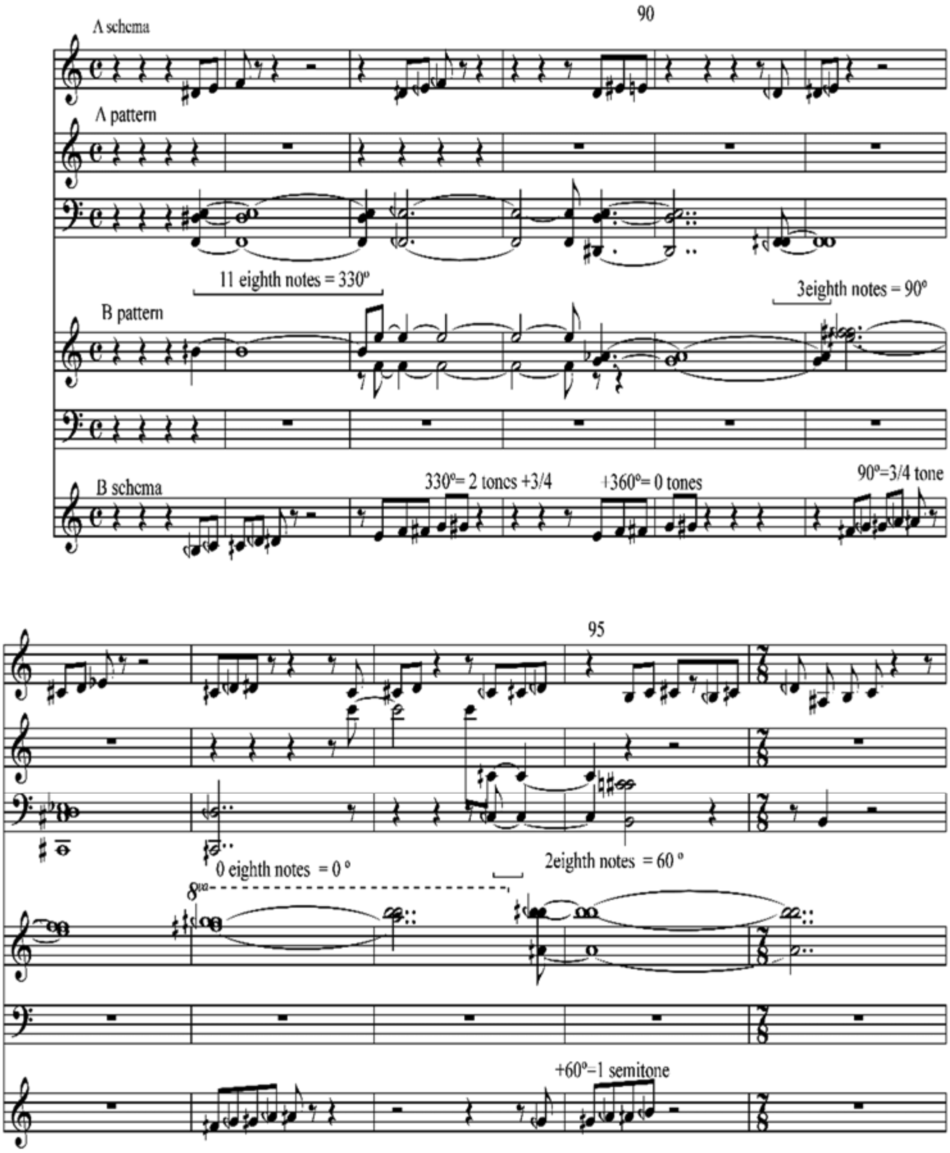
The note scheme of the modulation would thus be:



Pattern B changes in the modulation from the first element of Pattern A in the second section to the second element of this Pattern A in the second section (i.e., harmonics that evolve with a little pressure). At the same time, Pattern A remains basically the same, as in the first section, but the overpressure of the bow on the strings of the piano imitates the first attack of the pattern of the previous section. This is one of the most ambiguous modulations because all of the elements can be interpreted as belonging to any pattern. This results through the use of a rotary pattern-instrument distribution and the simultaneous entrance of both patterns that are also in phase with each other at the beginning of this section.

Once the modulation is established, each iteration of Pattern A lasts one eighth note less and each iteration of Pattern B lasts one eighth note more. Pattern A 's dynamics become quieter, while pattern *B*'s become louder over time. This leads to a curious phenomenon at the end of the part in which the extreme dynamics that correspond to this logic are musically impossible and not adequate for the instrumentation and the instrumental balance. This naturally advances us to the procedures that will appear later. Thus, an algorithmic rule is created that allows the dynamics to be changed. Thus, dynamics are increased by the end of the part according to this procedure.

The note scheme of the second part of the third section is:

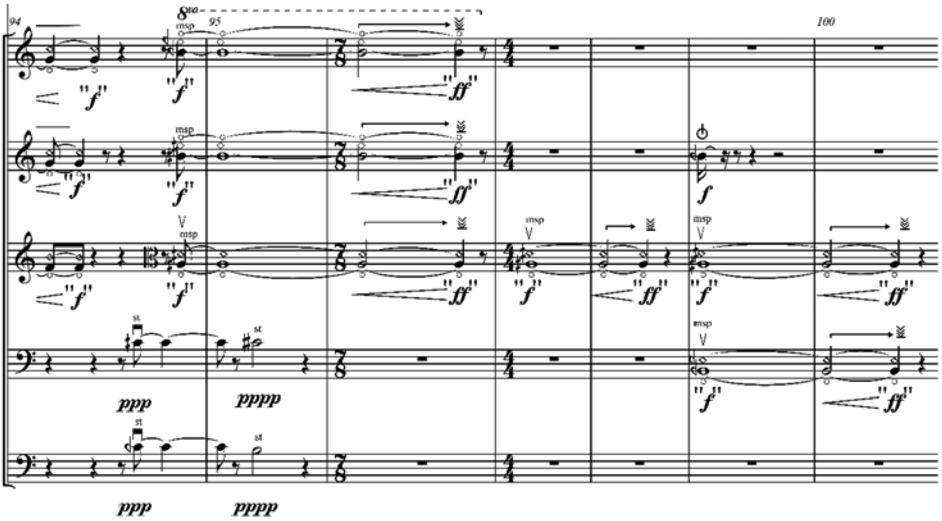


The change of the time signature in bar 96 allows the end of the section to match the duration of the latest iteration of Pattern B (16 eighth notes).

Third part

For the first time in the work, Pattern A also modifies its pitches depending on its degree of out of phase with respect to pattern *B*, thus continuing the logic of increasing directionality from the irregularity of the determinations produced by the previous out of phase durations. In the second part of this section, the pitches change steadily without being determined by the phase.

The viola is the instrument that does not vary in the pattern-instrument distribution and is used for modulating. The pattern-instrument distribution is: *A* (perc, vl1, cb) and *B* (vl2, pno, vla, cello).



Modulation from part 2 to part 3.

The modulation occurs from bars 97 to 98 (viola's harmonics on *A demisharp*). These two bars act as the center of the mirror between the second and third section. Pattern B continues more or less the same, with the pitches frozen during the modulation. Pattern A takes the element a of the Pattern B in the second section, consistent here in an eighth-note attack and a sustaining harmonic (bar 102, violin 1 performs the attack and the double bass performs the sustain).

The mirror in the modulation can be seen in the following scheme:

Bars 97 to 98 create the axis of symmetry of pattern *B.* Due to the processes used in the second part, Pattern A ends three eighth notes before pattern *B*, and then begins again three eighth notes after the start of pattern *B*. Thus, sections 2 and 3 form a mirror of durations, as seen below in the table.

A	12	11	…	11	12
B	11	12	…	12	11

Symmetry helps stress the importance of the unity of these two parts within the third section. This unity not only allows both patterns to enter in phase with one another at strategic moments, but it also specifically marks the start and end of this mirror. The symmetrical mirror is also repeated in terms of both dynamics and timbre, as indicated below:

A	*ffff > pppp*	*pppp < ffff*
B	*pppp < f*	*f > ppp*

The note scheme of this part is:

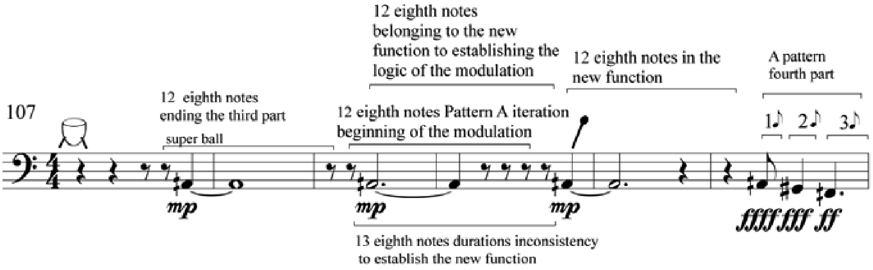
In this section, both patterns increase the quantity of notes, but there is a crossover in terms of dynamics: Pattern A increases from *pppp,* while *B* lowers a dynamic degree per iteration from *f*. The non-modification of the pitches underlines the ongoing process carried out by these two parts. The timbre changes by a certain degree per iteration in a similar manner as the dynamics, while the greater sense of freedom regarding which notes belong to the patterns is used to create some confusion. For example, Pattern A , which is the freer of the two patterns and formed by two gestures, is represented by the violin's timbral change by degrees from a normal sound to overpressure (the opposite than in the previous section), as well as the double bass performing the same process but with the addition of harmonics (retrograde concerning the other pattern). Instruments enter several times into phase (11 to 12, 12 to 11) to make the recognition of both patterns harder and to modify the speed of the introduction of material. Some iterations of *A* are elided, especially in the beginning.

Fourth part

The main function of this part is to provide the final cadenciation of this section and the first half of the work, preparing, in some way, for the end of the piece.

The common element for modulating pattern-instrument distributions is the percussion: the timpani passes from a *super ball* technique (which begins an eighth note late with respect to the beginning of its pattern because it was part of the resonance of the eighth-note attack) to a normal sticking to enhance the sudden change between the two sections. Modulation between the third and fourth parts is quite rough as compared with the previous ones; to put it simply, one process is finished while another begins. This modulation deliberately serves to establish this element as something different from the previous two. In the third section, both patterns align on the first eighth note in bar 109, which marks the beginning of the modulation. This modulation consists of two elements: the first is when both patterns remain in the same logic in bar

110, but whose frozen pitches enter in phase simultaneously to indicate the percussion’s association with the logic of section 2; and a second element formed by the percussion alone, which belongs to and anticipates the function of part 4. The *A demisharp* begins an eighth note later to resonate with Pattern A . Therefore, instead of eliding Pattern B as would be the logical technique, Pattern A continues to be active with the neutralized pitches. At the same time, however, the Pattern A lready belongs to the new logic of a duration of twelve eighth notes, producing the desired inconsistency that allows this dual function in the timpani during the modulation. Thus, the timpani in bars 109 to 111 perform a double function belonging to two different logics: it continues the logic of the previous bar (the delayed eighth note) while simultaneously freezing a pattern length of twelve eighth notes (considering that the pattern begins without delay). The *A demisharp* of bar 111 establishes this new function and the technique is changed to super ball, while dynamics are maintained as a common element (but will be changed later). In the first iteration of Pattern A in the fourth part, the pitch, the technique of interpretation, and timbre all remain without being changed, but the dynamics are changed in the fourth part, as already determined by the latest logic.


12 eighth notes belonging to the new function to establishing the logic of the modulation
12 eighth notes in the new function
A pattern fourth part
107
12 eighth notes ending the third part
super ball
12 eighth notes Pattern A iteration beginning of the modulation
1♪ 2♪ 3♪
mp
mp
mp
ffff fff ff
13 eighth notes durations inconsistency to establish the new function

Modulation from part 3 to part 4.

In the fourth part, both patterns increase their durations by an eighth note per iteration. Pattern A begins to last one eighth note and Pattern B ten eighth notes. The function of these initial durations is to mark a difference in respect to the previous section, when there was a cross of durations that allowed the first chords of Pattern B to be in phase, getting the pitches frozen, precluding a recognition of both patterns, and that the section is centered on *A*. Dynamics begin extremely loud and decrease at the rate of one degree per iteration; for example, the fact that both durations and dynamics came together in both patterns, as opposed to their reverse relationship in parts 2 and 3, is intended to separate this forth part and signify the cadenciatation. However, because the pitches don't follow the logic of the double mirror in the previous part and instead moved in parallel motion, they will move in the opposite manner in this section since the direction of the pitches in Pattern A is inversed. The note scheme is:

In this fourth part, the dynamics should decrease a degree per iteration as a general rule, but the parameter is subject to several exceptions. In this way, when the two patterns enter in phase, the dynamics of Pattern A are equaled to those of pattern *B*. This allows for a dynamic equilibrium when both patterns begin the attack together (i.e., when they are in phase) but is not necessary when they are not in phase, since the pattern with shorter durations has decreasing dynamics and a greater speed. For example, the second *D sharp* in piano and percussion in bar 115 should be *mp,* but it is increased to *f* to balance with pattern *B*, thus freezing the process of dynamic reduction. In the following out of phase period, the process returns at a *mp* (*A demisharp,* bar 116). The same technique appears in the second chord of bar 113.

The part ends centered and resolving on *A*, a fifth above the *E* that began the work, in order for the fifth section to signify the beginning of the recapitulation. A beat of silence is used as an introduction to the fourth section.

Fourth section

The fourth section is the central one of the entire piece, representing the moment that the determination flow of parameters is inversed. Here, instead of the position of one parameter determining the rest of the parameters, the duration and phase of one parameter is inversely determined by the rest of the parameters. This section breaks the centrality; until now, the phase has been between both patterns. Although the phase is not in itself perceptible, it is necessary in regard to the concept of the work that the flow determination is inverted at some point, so that the phase is what is determined. In other words, the parameters determine the position with respect to a particular cycle and a distance or phase concerning the beginning of the cycle.

This section is required to avoid a tautology, and its formal conditions must be considered as relative to satisfy the formalized nature of the work. Therefore, this section serves a formal need in the broadest sense of the term, not just in the musical sense. The formal function, with respect to the work when understood as a rondeau, occurs in part C. In cognitive-parametric music, the varied manner in which the parameters are determined indicates the type of material that differentiates one section from another. Therefore, it was necessary to introduce a different interrelation and parametric inter-definition from those in sections A (1 and 3) and B (2).

This section has three parts: the pitch determines the position in the first part; the second part represents the tautological moment in which no parameter determines anything since there is a closed relationship between them; and the timbre and dynamics determine the position and number of notes in the final and third part.

In this section, there is an alternation of parts in which parameters determine the position, and a central part in which they do not. Since this is the principal function of this section and it is how materials are defined, we can consider the form to be a, b, a'. The central section follows the rule that there should be an alternation in the generative type parts in the even-numbered sections, as opposed to the odd-numbered sections that only have development.

In addition, this section also anticipates certain elements that will appear in the remaining three sections of the work. It introduces the concept of continuous change in relation to the phase, as well as some of the piece's final preparations.

First part

The function of the first part in the fourth section is to inverse the determination flows so that the rest of the parameters are determined by the position of one with regard to the phase. In earlier sections, in order to get the phase to determine the rest of the parameters, it was necessary to use the position of a note determined by the phase of the iteration of two cyclic patterns through a function that linked the phase with the pitch [A=(12d/30)/360)]. To achieve the inverse, i.e., for the rest of the parameters to determine the position, the cycles are eliminated and thus indicate the phase, but a hidden cycle still remains to represent the described function. This hidden cycle is presented for the first time in this part and is a preparation of processes that will come later in sections 5 and 7.

In this first part, the dynamic and the timbre are neutralized, and the pitch is the only parameter to determine the position.

This creates a series of pitches – *C# sharp D, D sharp, E, F, F sharp, G, G sharp, A, A sharp,* and *B* – and its transpositions to two pitches, *A* and *D sharp*, which are chosen because they are the closest, without delving into quarter tones, to the notes of the previous section, thus acting as a continuity element. In this way, both patterns that govern the previous section are replaced by a two-voice polyphony, as based on the value of the last notes of these patterns. This part makes extensive use of this kind of two-voice polyphony, which is the superposition of the two patterns and whose correspondence between position and parameter function has a lot in common with the rest of the work.

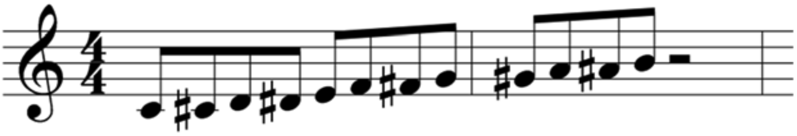
Thus, we have two series:

A, A#, B, C#, D, D#, E, F, F#, G, G#
D, D#, E, F, F#, G, G#, A, A#, B, C

To avoid predictability, the even values are permutated between the two series, resulting in two new series. For the first time, when one of the series finishes, its notes align with the other at the same time.

A, E, G, F#, F, G#, D#, A#, C#, C, B, D, A
D#, G#, F, F#, G, E, A, D, B, C, C#, A#, D#

The following portrays the correspondence between notes and its position in a cycle of 12 eighth notes, where *C* = 1, *C# =* 2, and so forth:



The note scheme is freely distributed among all the instruments, without any particular instrument corresponding to any one of these series.

We also created an algorithm, as described below.

We took the first note of a series and looked for the correspondence of the following note in the series to determine its duration. We then made the current note's duration a certain length to correspond with the following note and its position in the cycle that determines the correspondences. For example, the first note of the first series is *A.* By taking into account the second note, *E,* the *A* should last until the position of *E's* correspondence, which is the fifth eighth note. Therefore, the *A* lasts four eighth notes because the *E* corresponds to the fifth eighth note. Thus, the duration of a note is determined by the location of the next note in the series in the cycle of correspondence.

We carry out the same operation with the first note of the second series. We then repeat this operation in all the successive notes of both series until one of the series is finished.

The following formalizes this algorithm in pseudo-code:

```
Assign i = 1
Create matrixserie1($x_{12}$,$t_{12}$)
Create matrixserie2($x_{12}$,$t_{12}$)
Function AssignNoteDuration (matrixserie($x_i$))
      Take the last note as an argument $x_i$ and obtain its position in the table of correspondence and Assign to T1
            If $x_i$ is the first note of the series then $x_i$= 1
            Get the following note in the series ($x_{i+1}$) and obtain the position of $x_{i+1}$ in the table of correspondence and assign it to T2.
                  If T2 < T1 then T2 = T2 + 12
            Return as duration of the note matrixserie($t_i$) =(T1–T2) in eighth notes
      Repeat until i = 12
Assign NoteDuration(matrizserie1($x_i$))
Assign NoteDuration(matrizserie2($x_i$))
i = i + 1
```

With this algorithm, we obtain a base note, but to follow the general procedure of the work, each note would match three more in a continuous succession of quarter tones. To choose the number of notes from the four that would be used, we obtain the phase of the current note in relation to the other series and then multiply it by four and divide by 360. In other words, the number of notes selected is determined by the position of one of the series with respect to the other.

The note scheme is:

As you can see in the score example above, the second series ends first. The only exception is near the end, when the notes that correspond to *A sharp* from the second series are elongated until the end. Although *D sharp* appears as the following note of the second series, the corresponding notes to *A sharp* are not canceled, but instead maintained to overlap with the *A sharp* of the first series, anticipating a procedure that will take place at the end of the work. Another function of this part is to anticipate the end of the piece, where this procedure is used profusely. In this section, the voices are distributed freely among the instruments.

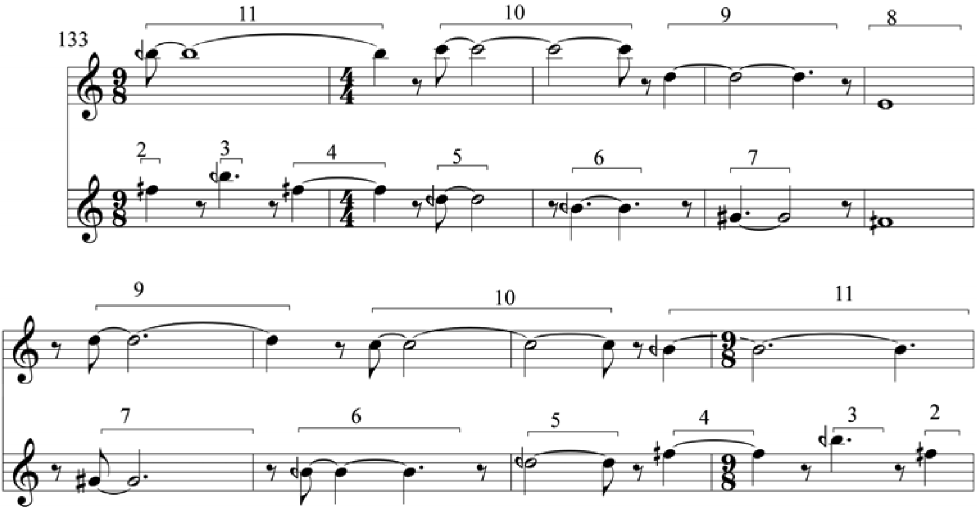
Second part

This is in fact the first fragment I composed for the work. I started with a fixed pitch and duration, a relationship that made the establishment of a determination flow impossible, which is why this is the tautological moment: the key is a fixed relationship between the pitches and durations. The following table is thus established:

Proportion	Interval	Base Note	Resulting Note
9/8	1 tone (major second)	*E*	*D*
10/8	2 tone (major third)	*E*	*C*
11/8	2 tones + 3/4 of tone	*E*	*B demiflat*
8/7	1 tone + 1/4 of tone	*F demisharp*	*G flat*
8/6	2 tones + 1/2 of tone (fourth)	*F demisharp*	*B demiflat*
8/5	2 tones (approx. major third)	*F demisharp*	*D demiflat*
8/4	octave	*F demisharp*	*F demisharp*
8/3	2 tones + 1/2 of tone (fourth)	*F demisharp*	*B demiflat*
8/2	octave	*F demisharp*	*F demisharp*

The part encompasses a simple two-voices polyphony with a center in bar 137 (*E, F* d*emisharp*).From this center, a retrogradation of the two freely-instrumented voices is produced.

The note scheme is:



The two notes in bar 137 are centrals. From this point, notes become an eighth note shorter in the second lower voice, and an eighth note is always inserted. Conversely, an eighth note is increasingly added in the upper voice. The time signature of 9/8 at the end is to match the durations.

In a way, this section is a parametric modulation between the first and third section. Such a thing would be somewhat unfair, however, in the sense that the modulation here is more important than the modulated parts; we might even say that the modulator element it is more important than the modulated ones.

This part, in a similar manner as the beginning of the work, demonstrates the relationship between speed and movement (such as duration), in the sense of the objects are shortened (shorter duration) when they move to a bigger speed (which reflects Einstein's Relativity Theory). By symbolically interpreting the duration as length, an inter-definition between space and time is produced.

Third part

This third part is similar to the first, except that timbre and dynamics determine the position instead of pitches. The pitches are neutralized like those that appear at the end of part one of this section.

This procedure is taken in part from the first two studies, functioning as a type of quotation of previous compositions.

In this part, a series of dynamics is associated with a certain cycle of eighth, in the same way that it is associated with a particular timbre in the first part. Since only ten dynamic levels are used in the work, this part will use a virtual ten eighth notes instead of the first section's cycle of twelve. The following table is used as a correspondence application:

Dynamics	*ffff*	*fff*	*ff*	*f*	*mf*	*mp*	*p*	*pp*	*PPP*	*pppp*
Eighth notes	1	2	3	4	5	6	7	8	9	10
Timbre: bowed strings	$\underline{\overset{\vee}{\overset{\vee}{\vee}}}$	$\underline{\overset{\vee}{\vee}}$	$\underline{\vee}$	Ord	Ord CL. tratto	Ord CL. tratto sp	Harmonic	Harmonic tratto	Harmonic tratto sp	Longitudinal Crini
Timbre: struck strings	⫰		CL. batt		Pizz.		Pizz. Harmonic		Pizz. Harmonic sp	
Piano	Sub bass register		Low register		Central register		High register		Over high register	
Percussion	Gong		Timpani with roller ball			Timpani with rod				

The dynamic series is constructed similarly to the pitches in one of the previous parts by step gradations:

ffff, fff, ff, f, mf, mp, p, pp, ppp, pppp

It is then split in half to avoid a too-predictable direction:

ff, f, mf, mp, p, pp, ppp, pppp, fff, ffff, ff

A second series is created by transposing the first one by two degrees:

mf, mp, p, pp, ppp, pppp ffff, fff, ff, f, mf

The even members are permutated between both series:

ff, mp, mf, pp, p, pppp, ppp, fff, ffff, f, ff,
mf, f, p, mp, ppp, pp, ffff, pppp, ff, fff, mf,

The pitches are neutralized in the same way the timbre and dynamics were neutralized in the first part. The basis for every one of the series that begins and ends the second part (i.e., *F* and *B demisharp*) are chosen as notes. The number of pitches is determined by the out of phase duration in eighth notes with respect to the other series, and the note basis is the center from which more notes are attached above and below.

The algorithm that determines the duration assigned to each dynamic is described below.

We took the first dynamics of a series and looked up the correspondence of the dynamics of the series to determine its duration. We made the current dynamic last until the point in which there is a correspondence between the following dynamic and its position in the cycle that determines the correspondences. For example, the first dynamic of the first series is *ff.* Since the second dynamic is *mp,* the first dynamic of *ff* will last until the *mp*'s position in the correspondence, which is the sixth eighth note. Therefore, *ff* last five eighth notes because the *mp* will start at the sixth eighth note. Thus, the duration of a dynamic is determined by the position of the following dynamic of the series in the cycle of correspondence.

The following formalizes this algorithm in pseudo-code:

```
assign i = 1
create matrixserie1($d_{10}$,$t_{10}$)
create matrixserie2($d_{10}$,$t_{10}$)
function AssignDynamicDuration (matrixserie($d_i$))
      Take the dynamic passed as argument $d_i$ and obtain
      its position in the correspondence table, assign
      it to T1
            if $d_i$ is the first dynamics of the
      series then $d_i$ = 1
                  Get the following note in the series
                  ($d_{i+1}$) and obtain the position
                  of $d_{I+1}$ in the correspondence table,
                  assign it to T2.
                  if T2 < T1 thenT2 = T2 + 12
                        return matrixserie($t_i$)=(T1–T2)
                  in eighth notes
             repeat until i = 12
     Assign DynamicDuration (matrixserie1($d_i$))
     Assign DynamicDuration (matrixserie2($d_i$))
      i = i + 1
```

The part begins in 9/8 with three eighth notes of silence to match the end of the section with the end of the bar and to produce a bar of separation between sections.

Unlike the first section in which any overlap of pitches is possible, there are certain overlaps of pitches in this section that can mask sounds since some dynamic markings are louder than others. For this reason, two timbral series are created: one associated with sustained sounds, and the other with decay sounds. This allows sounds to only be masked temporarily and briefly.

These procedures result in the following note scheme:

This section introduces a continuous change in parameter for the first time in the work since the timbre (overpressure - harmonics) evolves by an eighth note at a time in bars 147 and 146. This procedure, which is first introduced in this section, will be used in the fifth and seventh sections on a much larger scale. It represents the first appearance of the continuous glissando of the Doppler effect but is parametrically transposed to timbre.

Fifth section

First part

The fifth section is a recapitulation of the first section of the work, but it starts on *A* rather than *E* because the piano's prepared notes are *E* and *A*. Here, the durations of the repetitions of the pattern decrease each time by an eighth note. Pattern A begins with twelve eighth notes of duration (as in the first section) and decreases. Pattern B lasts nine eighth notes and ends with one eighth note (this time, the pattern does not start with silence). Pattern B is also delayed by two quarter notes in order to start with the same delay as Pattern A from the beginning of the work. The pitches are determined by the out of phase duration in the beginning of the pattern with respect to the other. Thus, in contrast to the first section, the out of phase durations are not cumulative. The instrumentation and the choice of the number of pitches attempt to imitate the beginning of the first section. The fact that the out of phase duration is not cumulative and regular as it was in the first section, means that it is possible for Pattern B in iterations 4 and 5 (bars 155–156) to have exactly the same notes and the same instrumentation as iterations 4 and 5 of the first section (bars 4–6), despite starting with different notes.
The dynamics are again frozen at *mp* as in the first section.
The note scheme is:

The first iteration begins with an out of phase duration of five eighth notes, formed by the four eighth notes of this section, plus the accumulated one at the end of part 4 of section 3.

The timbral instrumentation used in this section is very similar to section *a1*, since this is the recapitulation. The base notes from the end of part 4 of section 3 return to the flow of the odd-numbered sections. Every time the out of phase is 30 degrees, a quarter tone is added to *A* and rested to *B*, creating a contrary movement.

Second part

This section introduces a new element that will be dominant in the second part of the work: the virtual cycle. This element consists of an invisible pattern that does not exist, has no notes, and functions as a reference pattern to which the other two patterns are determined by its phase with respect to the cycle.
The second part introduces a new fundamental structural material. To underline this feature, all determination flows are inversed to generate the maximum contrast in relation to the first part (unlike the first section in which the first and second parts have a greater continuity). Therefore, the dynamics are no longer neutralized and vary from *pp* to *ff,* rising one degree per iteration. The pitches continue to be adjusted by a quarter tone for every 30 degrees, but now the phase used is the one against the imaginary pattern rather than the one between both patterns. The pitches in Pattern A reverse their direction, so now the out of phase duration determines by the decreasing of the notes. The pitch pattern's base notes are determined by the accumulated out of phase durations during the modulation. Pattern B has an interesting functionality, however; since the interval is determined by the cumulative out of phase duration, notes are the same whether the phase is added or substracted.[59] One exception, however, is the *F sharp* in the piano in bar

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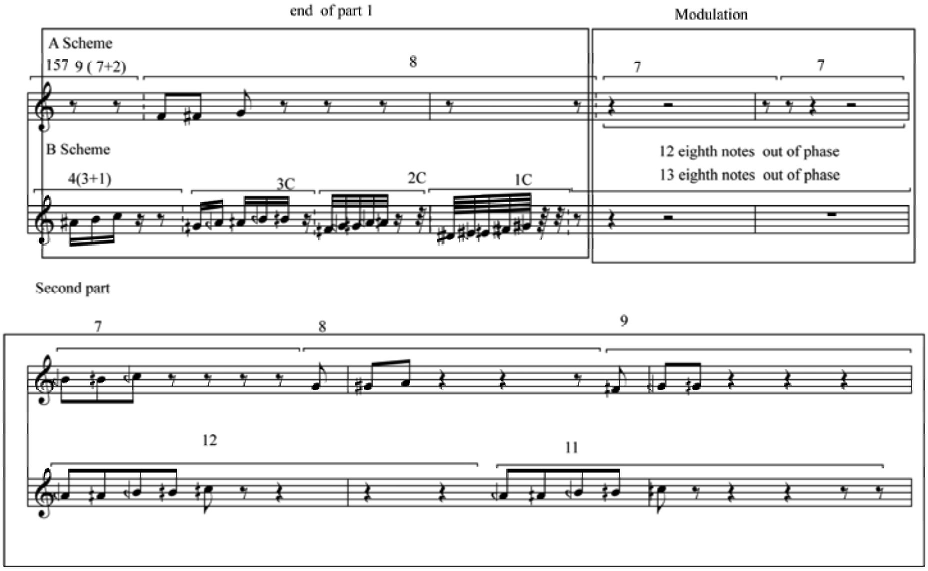
[59] The search function and the reason for establishing this technique is to deliberately prepare the objects in such a way that the base note is the same regardless of its operation (addition or subtraction) in order to generate a tautology, which renders the object meaningless. The point is to neutralize that certain element and rid its meaning, which, as we have seen, is a basic technique

141; rather than change to the expected *B* or *C* to respect the accumulated out of phase duration by its role in the modulation, the *F sharp* is maintained.

The piano is the instrument that does not change in the pattern-instrument distribution.

A (***Pno***, perc, cb1)	*A* (***Pno***, vl1, vl2)
B (vl1, vl2, vla, vcl)	*B* (perc, vla, vcl, cb)



Modulation from part 1 to part 2.

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in cognitive-parametric music. There are many examples of this at different levels throughout the work, creating small meaningless, is not possible to see all them in a detailed way.

The note scheme is:

Third part

In this section, for the first time in the work, the *change produced by the out of phase determination on parameters passes from being discrete to continuous*. In other words, instead of changing parameters through discrete jumps whenever a note begins, the change occurs continuously through glissando. This allows the function of the Doppler effect to become more obvious; although the concept undergirds the entire work at all times, it manifests itself more clearly in this section.

Element *b* of Pattern A of the second section that performed a glissando with harmonic and growing overpressure (bars 42–43) anticipates of the appearance of the glissandos in this section.

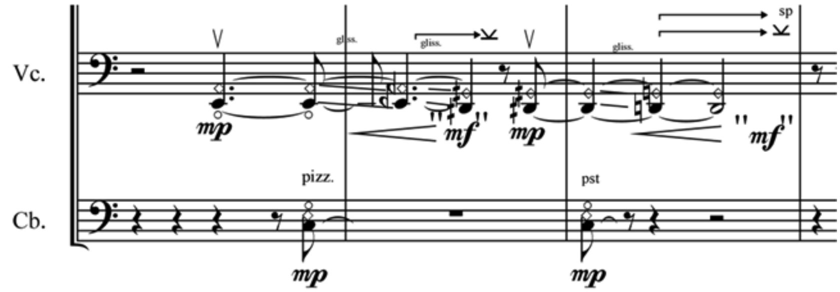
The modulation between the second and third part is very simple, allowing the second and third sections to form a triple mirror.

In the second part, Pattern A is lengthened from seven to twelve eighth notes, and Pattern B is shortened from twelve to seven. This process ends up in the first eighth note of bar 148. Since the instrument that is going to be used to modulate forms part of pattern *B*, the last iteration of the pattern's duration is repeated (seven eighth notes) in bar 167. Part 3 begins in bar 148 and reverses this process, i.e., Pattern B is is lengthened from seven to twelve eighth notes, and Pattern A is shortened from twelve to seven.

Part 2	Modulation	Part 3
A (***Pno***, vl1, vl2), 7 to 12	Cb.	*A* (***per***, vla, vcl), 12 to 7
B (perc, vla, vcl, **cb**), 12 to 7	Cb.	*B* (pno, vl1,vl2,**cb**), 7 to 12
Bar 160–161 eighth note Bar 167	7 eighth notes (duration taken from the continuation of pattern *B*) 7 latest eighth notes of bar 167 (center of the mirror)	Bar 168

The note scheme is:

Thus, item *A* of this pattern produces a continuous slide that begins when Pattern B has zero phases. The final note of the glissandos is determined by the out the phase length between both patterns.



In bar 168, both patterns are in phase, so there are no glissandos. In bar 169, there is an out of phase period, which signals the first appearance of the glissandos. The cello, which belongs to Pattern A , appears in the third quarter note in bar 169. The glissandos begin with the appearance of the first note of Pattern B (cb.), and, given that it begins three eighth notes later, the final note of the glissandos is three quarter tones lower than the initial note. The cello starts the third iteration in the last eighth note of the bar 170. When Pattern A begins its fourth iteration in bar 171, the glissando in the cello begins in bar 171 and decreases by only one quarter tone because there the out of phase duration between both patterns is only an eighth note. This is the general procedure, but there is an exception: if there are two notes that make the glissandos at the same time, the newer one repeats the glissandos of the other one on the previous iteration (e.g., the viola in bar 171).

Fourth part

The determination that the out of phase between patterns produces on the rest of the parameters is continuous in the fourth part of the fifth section. So far, the out of phase only determined parameters discreetly at the beginning of a pattern, but now the determination is continuous for some parameters, especially pitch, which causes it to change continuously. This has already been prepared in part 3 by small glissandos that were taken from sections 2 and 4 of the work.

The basic function of this part is to structurally introduce the continuous determination of the parameters. Thus, the introduction must be strongly prepared, and, as always, in order for the same parameter's continuous variation to lack interest, the determination process should provide a non-continuous variation.

In this fragment, there are continuous glissandos between the notes, which were previously determined discreetly. But to functionally establish the principle of continuous variation, the first glissandos occur at a rate of 1/4 tone per eighth note at the eighth iteration (*F demisharp* - *D demiflat*). This fact establishes all the fragment's construction. The determination of the pitches is identical to that of the previous part, i.e., whenever a pattern begins out of phase with respect to the hidden twelve eighth notes, it will determine the pitch. The only difference, however, is that the notes will slide to the pitches of the subsequent pattern following the rule that any pitch of the iteration can slide to any other pitch of the next iteration; if both patterns enter in phase, the notes do not slide.

To follow such a rule, *I have chosen a structure of pattern repetitions in which both patterns enter in phase with each other in the two first iterations*. The pattern-instrument distribution of notes is the quartet in Pattern A (to allow all instruments that can slide to do so) and the other instruments in Pattern B (cb, piano, and perc).

The modulation is very simple and similar to the one made between parts 2 and 3. It uses percussion as the common element for the same pattern in both parts. The third section ends on the first eighth note of bar 175 with a duration of seven eighth notes (since Pattern B also modulates between parts 2 and three with seven eighth notes of duration, given that the pattern durations are inversed with respect to the other between these two parts). Thus, the modulation lasts only seven eighth notes, iterated by percussion through the cymbal played with a bow. The new part begins as a block in bar 176. Throughout the process of block modulation, twelve eighth notes of the hidden pattern continue unchanged, which determines that the first out of phase moment will occur in bar 176.

	Part 2	MOD	Part 3	MOD	Part 4
A Pattern	7 to 12		12 to 7	7	5 to 11
B Pattern	12 to 7	7	7 to 12		11 to 5

The note scheme is:

I created a structure to meet the objectives of part 4. In it, Pattern A starts with a duration of five eighth notes and increases its duration by an eighth note per iteration until it has a length of eleven eighth notes. Pattern *B*, which is the one that slides, performs the inverse, i.e., it starts with a duration of eleven eighth notes and reduces its duration by an eighth note at each iteration. This structure prevents Pattern B from sliding in the first or second iteration since it enters in phase with Pattern A . This is because the sum of the first two iterations of the pattern (5 and 6) and the duration of Pattern B (11) are equal. As a result of this equivalence, they entered in phase with one another to produce a mirror structure in three parts. *Pattern A* slides in turn with the same algorithm used in part 3.

	Part 1		Part 2				Part 3	
pattern A	5	6	7	8	9	10	11	
pattern B	11		10	9	8	7	6	5

Part 1 anticipates the introduction of the system, which has two readings: one equal to the previous logic, and another that validates the creation of a new preparatory modulation. The glissandos appear in the second part in the nineth iteration. The third part serves as both a mirror and a cadenciation for the entire fifth section.

The dynamics are free, despite the fact that the number of notes that slide is free as well. The dynamics increase by one per iteration and the speed of the glissandos slows down.

As I have said previously, the eighth iteration is the structural center; therefore, it has unique glissandos that move a quarter tone each eighth note. The glissandos move twice as fast in the previous iteration, as well as in the next half of the part. Thus, the underlying of this center is established as a settling fact but with changing speed. It also sets an inverse relationship between the glissandos' speed and the number of notes, meaning that a greater number of notes will indicate a slower glissando speed. The dynamics are still free. Pattern A reverses the direction of the determination from least to most in order to highlight a certain discontinuity with respect to the previous part. It follows the same rule in both parts regarding the rest of things.

Sixth section

This section has two distinguishable functions: in on way, it acts as a recapitulation to the second section, but in another way, it is considered the *D* element of the rondeau. These two readings reveal how the section serves an ambiguous purpose in the work.

If we consider this section as a mere recapitulation of the second section, then the structure of the work would be:

Section 1	2	3	4	5	6	7
A	B	A	C	A	B	A

I would be remiss of me to state that the second *B* section was a D to indicate a rondeau, but on the other hand, this structure reveals a mirror in which C is the center.

If we consider this section as new material, then the structure of the work would be:

Section 1	2	3	4	5	6	7
A	B	A	C	A	D	A

These two possibilities indicate the ambiguous and intermediate role that this section, allowing a reading of the work as a rondeau or a mirror that depends on the relationship between the present memory window and the long-term memory that, as we have seen, depends on the pattern recognition related to the perception of the psychological experience of the time. In this way, the recognition of the form depends on one's experience of the tempo and its relation to the time.

The sixth section is a recapitulation of the second, following the same procedures. However, the rigid odd-numbered sections from the second section are now characterized with less rigor and demonstrate a greater degree of freedom. But both are a collation of cells according to a generative algorithm, in which the parameters of the sound events of the two elements of each Pattern A re determined by the iteration of its own pattern, regardless of the out of phase or iterations of the rest of the cells.

Here is a generative outline of the second section with three levels of iteration:

ABAC	ABDC	ABAC	DBDC
AB	AC	AB	DC
A	B	A	C

Although this section is based on the second, in order to fulfill its function, a reduced intelligibility is required to generate a greater unpredictability. This section could be confused, to some extent, with sections 3 and 5, so a sense of a literal recapitulation at the level of listening should be avoided. Everything within the listening experience should thus be focused on the search for a greater ambiguity. To achieve this, the generative algorithm remains the same, but the first level is a retrograde of the second section, while the second and third levels are not retrograded. That is what gives it the following cell intercalation scheme:

DBDC	ABAC	ABDC	ABAC
DC	AB	AC	AB
C	A	B	A

This form of operation implies a non-literal retrogradation (on a formally literal inversion) that avoid two things: a literal repetition of the algorithm of the second section, and a literal mirror inversion of the second section.

If a literal retrogradation had occurred, we would have obtained the following in the third level of iteration:

CDBC	CABA	CDBA	CABA

Instead of:

DBDC	ABAC	ABDC	ABAC

In the same way that the generative algorithm is adapted to the new function of ambiguity, the evolution of each one of the cell patterns is also adapted to this new feature.

For this reason, in contrast to the second section, there are no changes of time signature; instead, all cells are fused continuously, avoiding highlight cell patterns. In addition, the order of appearance of the cells' iterations is permuted. For example, in pattern *D*, which is the first pattern to appear in second section, a quarter note is annexed per iteration to the duration of the cell, so it reappears with one less dynamic degree. In the sixth section, however, it is permuted, so it appears in the following manner:

	1	2	3
Section 2	(D1)Duration of 8 quarter notes Begins at *mf*	(D2)Duration of 9 quarter notes Begins at *mf*	(D3)Duration of 10 quarter notes Begins at *mf*
Section 6	(D1)Duration of 8 quarter notes Begins at *mf*	(D3)Duration of 10 quarter notes Begins at *p*	(D2)Duration of 9 quarter notes Begins at *mp*

The logical order of appearance is thus changed, permuting D2 for D3 to prevent the predictability of the second section.

In each of the patterns in the section, two cells will undergo a series of changes in the way in which their parameters are associated to others, which in turn will vary from one cell pattern to another.

Another mechanism that reinforces the ambiguity of this section with respect to the second is the inversion of determination flows of parameters. In addition, some flows follow iterations, while others follow the order of the permutated pattern cells' actual appearance.

If we take into account, with respect to what was said about the formal ambiguity, that the *A* element is really the new *E*, and that the *C* element of this section is equivalent to the *A* of the previous section, then instead of:

DBDC	ABAC	ABDC	ABAC

We obtain:

DBDA	EBEC	EBDA	EBEC

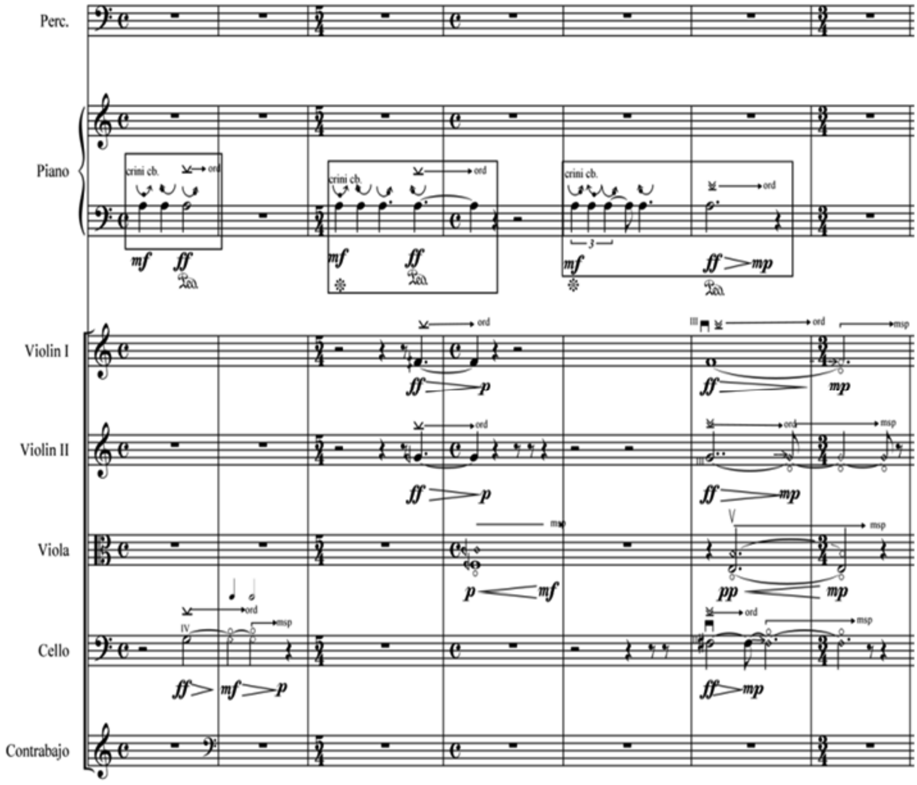
Depending on the way that a listener recognizes patterns, he will either recognize a rondeau or a freer structure.

Pattern D

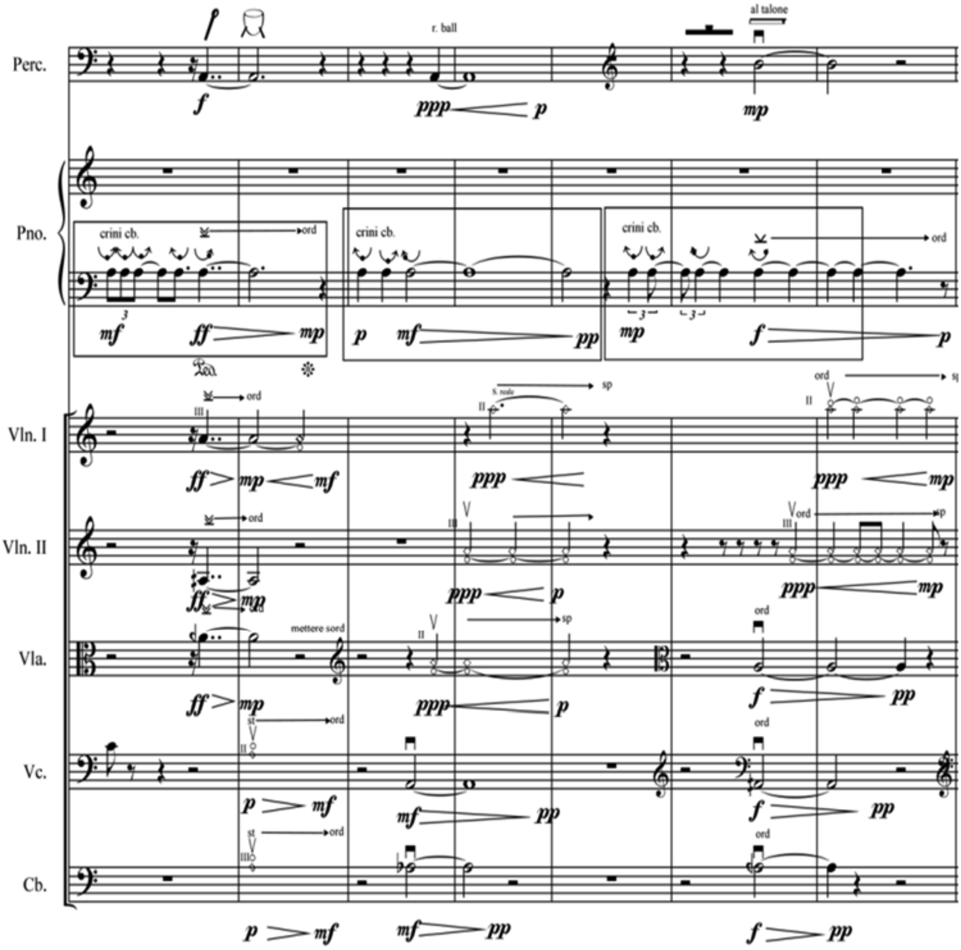
The first element is based on several repetitions of *A* with cb. crini. at the piano, ending with slight overpressure. In each iteration in the second section, the number of successive notes of crini at the piano before the slight overpressure implies an increase in the number of notes. In the sixth section, this relation is inverted: the number of notes is less with each repetition, and thus the relationship between the duration of the Pattern A nd the number of cb. crini notes before the slight overpressure are inversed. In the second section, the dynamics were frozen, but will be decreased here every iteration.

The relationship of the parameters in the second element of the pattern cell *D* is also inversed: the second element consists of a cluster of up to four notes that evolves from an overpressure timbre to harmonic sounds, with pitches always focused on *G*. However, the relationship with respect to duration it reversed. Now, the four notes are present in short iterations, and the number of notes decrease as they are lengthened, which is focused on *A*. But the rule remains and is applied in the second section concerning the alternation of microintervals (i.e., the odd-numbered iterations have microintervals, while the even-numbered ones do not). In the sixth section, the same rule is applied, but to the actual order of the appearances of cell patterns instead of the iterations.

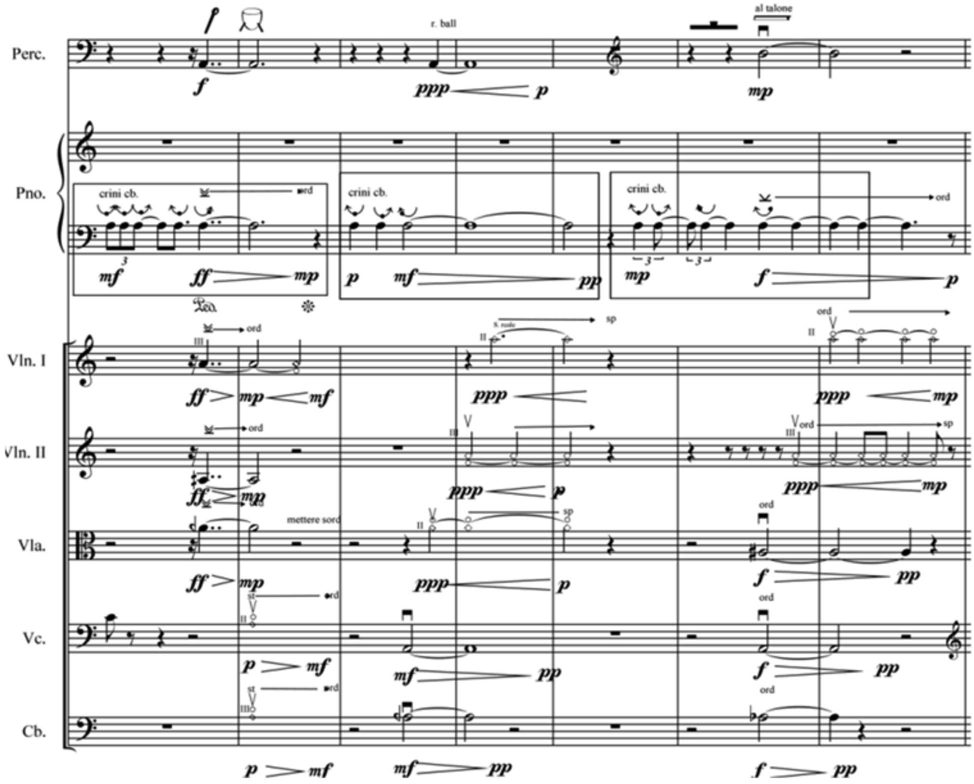
Here, we can see pattern *D* as it is in section 2:



Here it is in section 6:



Here, we see how it would have looked if we had applied all the parameters in a non-sequential form:



Pattern B

Pattern cell *B* sequentially reveals all its iterations; therefore, there is no difference between parameters applied in the iterations sequentially and not sequentially. The order of the appearance of the cells is B1-B2-B3-B4. Pattern B consists of two elements, but one is null: it is completely elided and imaginary. The other is composed of a cluster attack of two or three notes centered on *A* that resolves on one or several notes approximately an octave above the first attack in harmonics. It differs from its appearance in section 2, in which attacks were via overpressure and endured a timbral evolution; here, it is more neutralized. In addition, the duration of attack *B* was always the same, but here in the sixth section, the duration of the attack changes per iteration. Dynamics are neutralized around *mf* in the attack, and *mp* in the harmonics.

In short, each iteration increases the number of attacks, reduces the duration of the note's attack, increases the duration of the cell by an eighth note, and slightly decreases the duration of sustained harmonics, but it increases its number of notes.

Iteration	B1	B2	B3	B4
Number of attacks	1	2	3	4
Duration of attack	quarter note	dotted eighth note	eighth note	changing
Notes on the attack	2	2	3	4
Duration of the cell in quarter notes	8	9	10	11
Number of harmonic notes	1	2	3	2
Duration of last sustaining harmonic	6 quarter notes	5.75 quarter notes	5 quarter notes	3.75 quarter notes

Pattern C

This pattern in the sixth section is a modification of the *A* in the second section in order to introduce ambiguity. Pattern *C* of the second section is removed and replaced with a modification of the second section’s A pattern to present a new pattern in the sixth section.

The modification with respect to the pattern of the second section is that *ord.* notes are replaced by muted natural harmonics.

In this case ,the order of appearance of the cells is C2, C1, C3, and C4.

The duration of the cells is inversed: the first cell lasts for eleven quarter notes, and one quarter note of duration is lost at each iteration of the cell. The number of notes increases by two every iteration, beginning with two notes in the first iteration.

The global envelope is inversed: at the beginning, the higher notes last the longest, but by the end, the bass notes last longer.

Iteration	C1	C2	C3	C4
Number of notes	2	4	6	8
Duration of high note (relative to the duration of the pattern)	10.5	9	5	3
Dur. note bass (relative to the duration of the pattern)	(elided) 4	5.5	7.5	8
Duration of the cell in quarter notes	11	10	9	8

Pattern A

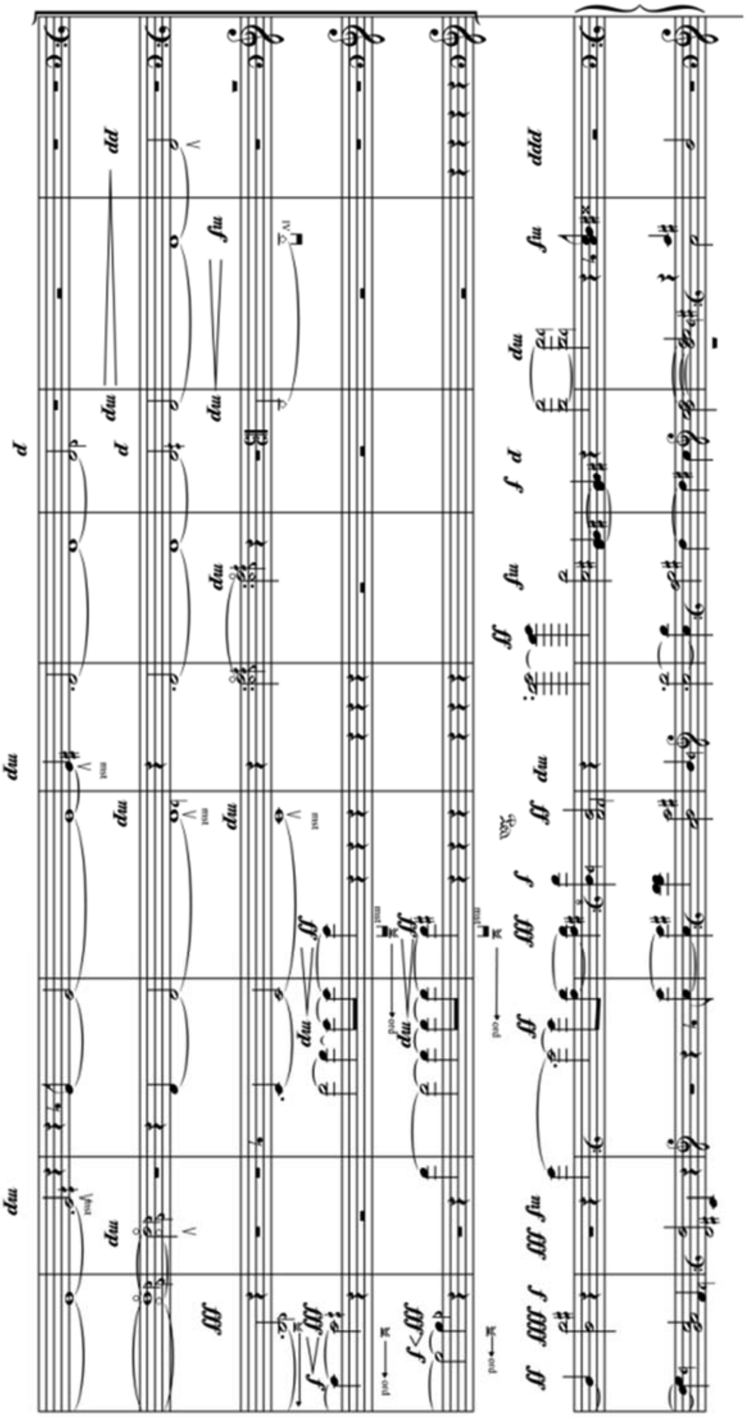
This is the most important Pattern A nd is the new material included in this section. It consists of two elements: the first is a sequence of chords on the piano incremented per iteration, and the percussion always strengthens one of these chords; and the second is a chord formed by the strings whose notes appear gradually according to the occurrence of the sequence of chords on the piano. The notes of the chord are divided into two groups according to dynamics: one group usually begins with a quiet dynamic and crescendos, and the other begins with a loud dynamic and diminuendos. The latter group begins with harmonics in terms of timbre, evolving to a sound of bow overpressure in the last iterations. Some of the parameters evolve according to the order of iteration, while others change to the actual order of appearance of the iterations. The dynamics increase by one degree per iteration, except between iterations two and three, in which they are permuted.

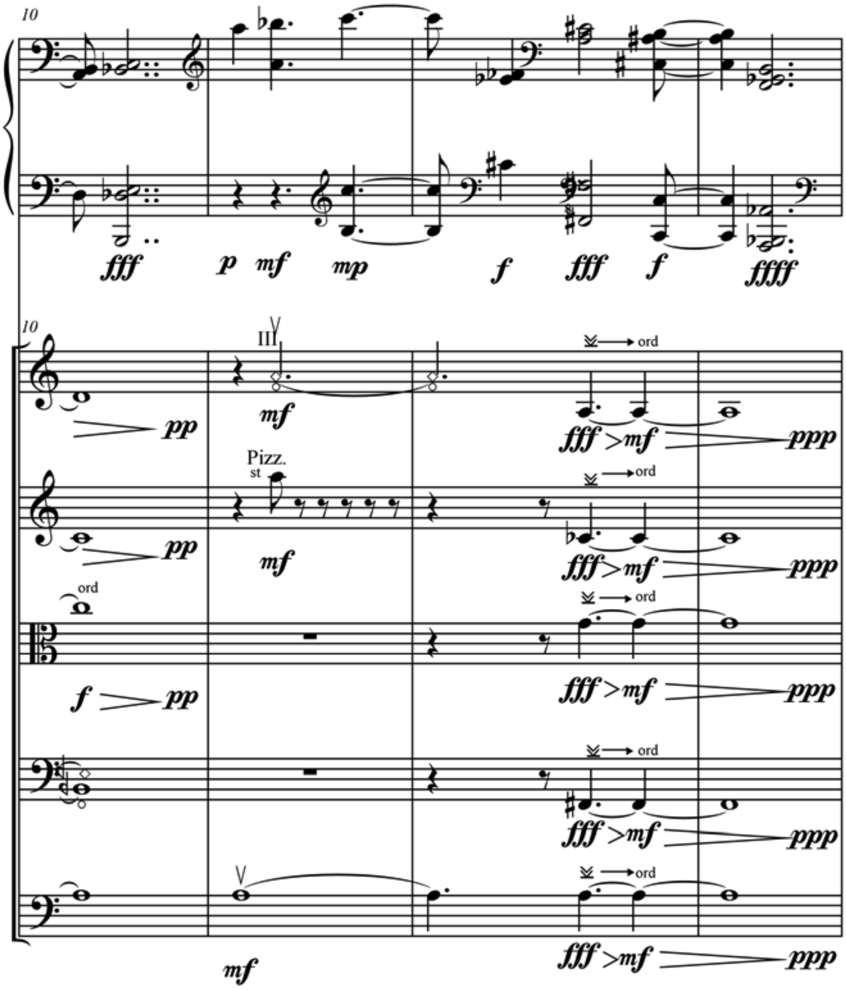
The order of appearance of the iterations is A1-A2-A3-A4-A5.

The two elements start in *B* as a base note, but each one of them evolves differently. The *A* element evolves similarly as *End Game*; in fact, there are various elements in the *A* cell of the fourth section in A cell that can be considered quotations from the other two studies. In this pattern in particular, there are elements that quote aspects of *End Game.* The b element used in clusters is focused on *B*, but with quarter tones in even-numbered iterations and semitones in the odd-numbered ones.

Iteration	A1	A2	A3	A4	A5
Number of line item *A*	3	4	5	6	7
Duration of pattern cell	8	9	10	11	12
Note dynamic base element *B*	*pp*	*p*	*mp*	*mp*	*mf*
Note dynamic base element *A*	*pp*	*p*	*mp*	*mf*	*p*

Assembling the iterations of the pattern by order of appearance (omitting the percussion) would look like this:


mp
p
pp
ppp
mf
f
ff
fff
ffff
ord
mst
IV


10
fff
p
mf
mp
f
fff
f
ffff
10
III
mf
pp
Pizz.
st
ord
ord
f
fff >mf
ppp

Seventh section

The seventh section is a recapitulation of the third one. The introduction of changes in this section will occur through three strategies:

1. The relationship between the out of phase and pitch will be altered. In the first part, the phase will determine the pitch at the rate of a semitone (instead of a quarter tone) every 30 degrees in the Pattern A . This makes the *perpetuum mobile* faster in practice and removes the presence of any microtones.
2. Instead of using the first pitch in the note scheme as the base note, the last one will be used.
3. Once both patterns utilize the new relationship between out of phase lengths and pitches, a set of notes that ascend or descend by conjunct degrees of quarter tones (rather than semitones) will be used.

These three strategies are introduced gradually so that a few slight modifications caused by their introductions provide a subtle appearance of a change in the introduction of new material and cause a sense of unpredictability in the listener. These strategies provide us with the necessary change in the perception of the introductory speed of new materials without such speed actually being real.

In the first part, we introduce strategy 1 on Pattern A , i.e., the change in the out of phase rate. In pattern B, we introduce the use of the last note of the note scheme as a reference for the calculation of the out of phase rate. The consequence is that only semitones are used in Pattern A , while both semitones and quarter tones are used in pattern B. Part 2 introduces the use of the last note as a reference to Pattern A . Although no new element is inserted into pattern B, it begins to undergo the continuous transformation first introduced in section 5.

In addition, this section also has a mirror structure in which parts 2 and 3 work as the center.

First part

In a similar way as Pattern A in the third part, this part is based on Pattern A in the second section. Here, Pattern A derives from cell Pattern A of the sixth section, which has an equivalent function and consists of percussion, piano, and violin 2. However, this choice of pattern-instrument distribution is an inversion of the pattern-instrument distribution in the first part of the third section, in which Pattern A is formed by all the strings except violin 1. Taking advantage of the ambiguity that violin 1 and violin 2 provide,[60] the Pattern B is composed of violin 1, viola, cello, and double bass. This inversion prevents the listener from recognizing the material that appears in this section as the recapitulation.

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[60] Here, we have another example of a neutral element applied to the instrumentation. The ambiguous nature of violin 1 and 2's parts allows functionally different things to appear as the same element. This hampers cognition and constructs two different planes, one related to listening and the other to writing.

The note scheme is:

As we have seen before, the patterns differ in how the out of phase length determines the pitches. In Pattern A , every 30 degrees are equivalent to a semitone (i.e., an eighth note), while in pattern B, 30 degrees are equivalent to a quarter tone. The speed of the *perpetuum mobile* is greater in Pattern A , which is less perceptible. Pattern B follows the same logic as in the previous parts. Both patterns begin with the same base notes that ended the fifth section, returning to its *perpetuum mobile*. This is because the fifth section ends at the same time that the virtual cycle has a length of twelve eighth notes, and this section begins with a cycle of twelve eighth notes in phase, so the cumulative phase is zero.

The timbre is free, but it generally comes from cell Pattern A of the sixth section. The dynamics will decrease from *fff* to *ppp* at a rate of one grade per iteration. Pattern B performs the reverse action, starting from *ppp* and increasing one degree per iteration to *fff*. In both cases, the louder dynamics are associated with an overpressure timbre, but since Pattern B consists of only harmonics, such dynamic changes are not actually real.

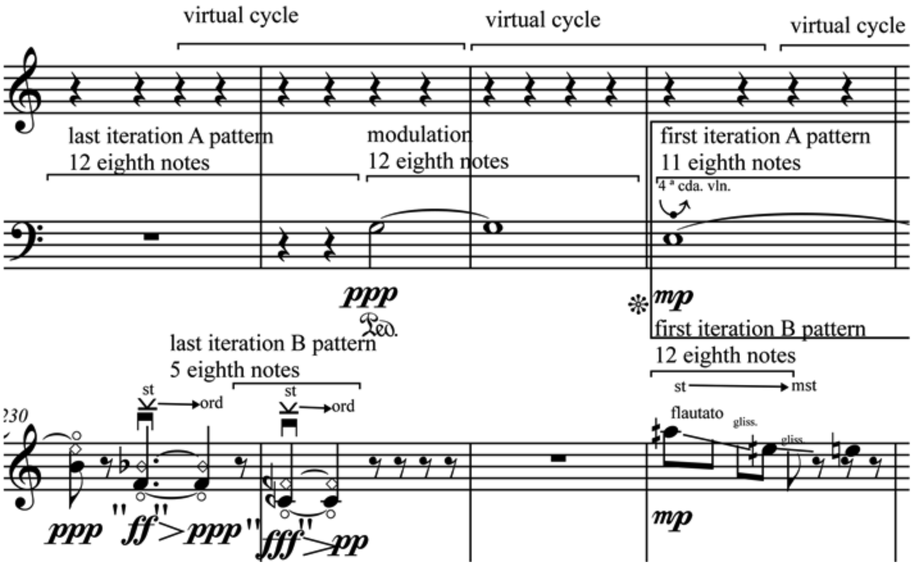
In Pattern A , the pitches ascend, but in pattern B, they descend. As the durations in Pattern A begin with five eighth notes and increase to twelve, adding one eighth note per iteration, Pattern B does the opposite, beginning with twelve eighth notes and ending in five, and decreasing by an eighth note per iteration.

In other words, all parameters are inversed from one pattern with respect to the other.

We can see how to use the last note as a reference for the addition or subtraction because the notes are still moving even if patterns enter in phase. In bar 224, both patterns enter in phase; therefore, if we had used the same criteria until this point, the same notes would be repeated, but by using the last note (*D* demiflat) instead, the notes move despite an out of phase rate of zero.

Second part

The modulation between the first and second part is very simple. The piano is the modulating instrument that doubles the duration of the latest iteration of the pattern (twelve eighth notes). Thus, just the monolithic block of the first part is followed by the *G* of the piano, and the monolithic block of part 2 at the end.



Modulation from part 1 to part 2, section 7.

The change of pattern-instrument distribution is:

Part 1	Part 2
A (***Pno***, perc, vl2)	A (***Pno***, vl2, cb)
B (vl1, vla vcl, cb)	B (perc, vl1, vla, vcl)

This second part, as we have seen, is introduced as a reference to the sum of the out of phase degree and the last note of the note scheme in both patterns. The direction of the pitches is inversed with respect to the first section. In this way, the pitches will ascend in Pattern A but will descend in pattern B. The reason for this is to reinforce the mirror formed by the second and third parts as a unit within this section. For the same reason, the durations of the iterations that change from five to twelve eighth notes in the first part to eleven to five in the second part are reversed with respect to the previous section. In this way, Pattern A starts with eleven eighth notes and reduces by an eighth note on each iteration, while Pattern B begins with five and increases by an eighth note in each iteration.

The dynamic and the timbre are free, although the dynamics in Pattern A diminuendo.

Furthermore, the continuous change of parameters returns in pattern B, and the glissandos in the pitches appear again. The fourth and fifth iterations of Pattern B are completely elided to prepare the end, thus changing how the glissandos behave. In the first three iterations, the glissando begins with a note from the note scheme of the current iteration and concludes with a note of the next iteration. In the last two iterations, the glissando begins with a note from the previous iteration group and concludes with a note of the current iteration. The third iteration is an intermediary of these two forms in which the glissandos begin with a note belonging to its iteration and conclude with notes belonging to the previous iteration scheme. Eliding the fourth iteration prevents the third from resolving on a note of the third iteration’s note scheme, or on a free note which does not belong that is possibly from the previous scheme, the future scheme, or the current scheme. This process anticipates the following non-elided iterations.

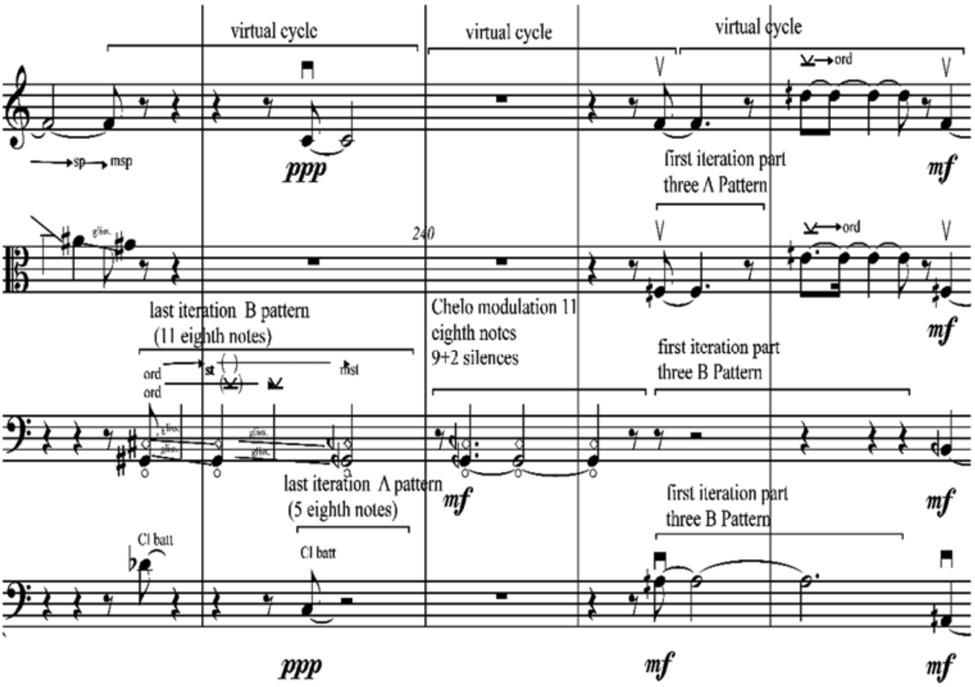
The note scheme is:

Third part

The modulation of the pattern-instrument distribution between the second and third parts is also very simple and is basically the same as the one between the first and second parts. The virtual cycle continues its movement without interruption, and the modulation assumes the duration of the latest iteration of the pattern to which the modulator instrument belongs between the two monolithic blocks of parts two and three. In this case, the cello belonging to Pattern B assumes the pitch and duration of the latest iteration of its corresponding pattern:

Part 2	Part 3
A (Pno, vl2, cb)	A (Pno, vla, vl2)
B (perc, vl1, vla, **vcl**)	B (perc, vl1, **vcl,** cb)

The modulation scheme can thus be seen as:


virtual cycle
virtual cycle
virtual cycle
sp
msp
ppp
first iteration part three A Pattern
ord
mf
240
gliss.
ord
mf
last iteration B pattern (11 eighth notes)
Chelo modulation 11 eighth notes 9+2 silences
first iteration part three B Pattern
ord
ord
st
msl
gliss.
last iteration A pattern (5 eighth notes)
mf
mf
Cl batt
Cl batt
first iteration part three B Pattern
ppp
mf
mf

In the third part, the durations increase per iteration and their direction is inverted. A central section is established, forming a triple mirror.

	Part 1	Part 2	Part 3	Part 4
Pattern A	5 to 12	11 to 5	5 to 11	5 to 12
Pattern B	12 to 5	5 to 11	11 to 5	4 to 11

The dynamics and timbre are still free.

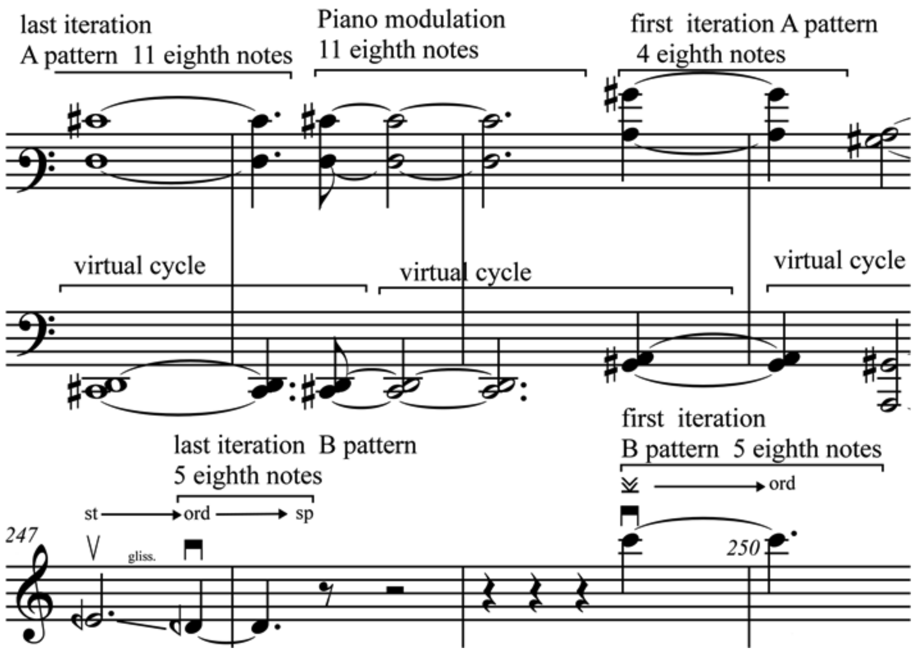
The direction of the increasing pitches does not undergo any modification in order to underline the block of the second and third parts. For the first time, Pattern B will undergo an increase in pitches at the rate of one semitone per 30 degrees, and the set of notes based on a single note is carried out by joint grades of a quarter tone.

The note scheme is:

In this third part, continuous determinations changes are used only when Pattern B enters in phase with the virtual cycle, and always begin with a note from the own iteration to a note from the following iteration.

Fourth part

In general, the modulation of the pattern-instrument distributions between the third and the fourth parts follows the same strategy as the rest of the modulations in this section. However, for the first time in the entire work, I use an instrument that is not common to both distributions to modulate: the piano. I should have used percussion as the modulator instrument, but it is necessary to introduce an exception to mark the cadential character of this modulation as I prep for the end. The fourth part of the seventh section is the end of the work, which suggests the use of certain exceptions. First, I use the piano as a cadential function, which generates a symmetrical structure between the beginning of this section and the beginning of the work; therefore, the use of the piano in this latest modulation closes several cycles to allow for the conclusion of the *perpetuum mobile.* I have chosen to do this as an exception because some traditional music employs two different elements in the final preparatory stage: one element that is fairly distinguishable from the rest that marks and encodes the end of the work, and another that represents a return to one that is quite prominent and conclusive. Both of these elements are present in this last section. There are multiple other exceptions that also give the ending a unique flavor with a strong final sense.



Part 3	Part 4
A (**pno**, vla, vl2)	*A* (vl1, vl2 ,vla)
B (perc, vl1, vcl, cb)	*B* (per**, pno,** cb, vcl)

Continuing with this line of exceptions, the duration of the iteration was determined in order to make a difference with respect to the central block, as formed by parts two and three, to ensure that Pattern A imitates the same structure from the first part, i.e., that the duration of the iteration would begin with five eighth notes and increase its duration by an eighth note in each iteration. However, it is necessary to generate an anomaly with regard to pattern B; the function in both patterns is to start with a small duration and increase it to generate a sense of a cadential ritardando. Therefore, there cannot be a crossover as in the other three parts of this section, but to avoid both starting in phase with each other, the durations of both patterns must be different. Thus, Pattern B will begin the first iteration with four eighth notes and will increase it at a rate of one eighth note per iteration. If we go on with this logic, we will have a block in which both patterns would not end at the same time, so to avoid this, the repetition of an iteration (the five eighth

notes) is allowed. Thus, the total length of the sum of the iterations of both patterns will be the same; this exception also opens a lot of other interesting possibilities.
Thus, the duration of the iteration is:

5-6-7-8-9-10-11-12 Pattern A
4-5-6-7-8-8-9-10-11 Pattern B

Pattern B will have one more iteration, doubling the iteration 5, which has a value of eight eighth notes. This allows the work to conclude on *A*.
As a conclusion to the process of introducing the speed of the materials, both patterns can finally finish by implementing the three strategies that were discussed at the beginning of this section. Both take the last note as a reference for increasing their durations, and both use a set of notes by joint degrees of a quarter tone as a note scheme. Both patterns inverse the direction of the notes, which increases with respect to the third part; thus, Pattern A changed from an ascending to a descending pattern, and vice versa. The reason for this is, once again, to indicate the cadential contrast with the two previous central parts.
Dynamics in both patterns will begin at *ff* and will progressively diminuendo, with the exception of the second iteration of the pattern that will increase to *fff*. This exception has the same function as the rest of the exceptions in this part. Moreover, it was already anticipated in the fourth part of section three, for which this section is its recapitulation. The timbre is free.

The note scheme is:

With respect to the duration of the notes in this part, the concatenation of the notes of two iterations is allowed as a cadential function if they have the same note. For example, the cello and double bass concatenated the first two iterations of Pattern B with an *A demisharp* and *A demiflat* respectively. Elisions of iterations are also allowed, the first one being the fifth iteration of both patterns. The sixth and seventh iterations of *Pattern B* are also concatenated, as well as the second and third iterations of Pattern A around the *E*.

The seventh iteration of Pattern B applies another exception with regard to the patterns of notes. Once the last note of the note scheme (instead of the first) is used as a reference for the increase of the base note, there is an increase of one tone when the two patterns enter in phase. Such a rule would create a small anomaly since negative increments would paradoxically produce an increase when the patterns entered into phase. To avoid this, an exception is made to allow the work to end with Pattern A *,* but we still follow the general rule of not increasing the base note when patterns enter in phase.

Predicative-Aggregative formalization of the work[61]

Sets

Set ***N*** of ***n*** parameters
N = {*pitch, beginning of the note, end of the note, timbre, dynamics*}
N = {*a, cn, fn, t, d*}

L subsets of ***N*** sets
L = {*pitch, beginning of the note, end of the note*}
L' = {*pitch, beginning of the note, end of the note, timbre*}

L'' = {*pitch, beginning of the note, end of the note, timbre, dynamics*}

Set of (metaparameters) ***M***

M = {*phase, accumulated phase, phase with respect to the virtual cycle, accumulated phase with respect to the virtual cycle, iteration of the pattern, the pattern, pitch base length, note base*}

Set of reference systems

K= {*Pattern A , pattern B*}

Reference system

Pattern A = {*pitch, beginning of the note, end of the note, timbre, dynamics*}
Pattern B = {*pitch, beginning of the note, end of the note, timbre, dynamics*}
Set of events of ***E*** = {***e***, $\boldsymbol{e_1}$,..., ***n***} belonging to ***Pattern A***

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[61] See chapter 4 for more details.

Set of events of ***E'*** = {***e'***, e'_1,..., ***n'***} belonging to ***pattern B***
Events ***e*** = {***a, cn, fn, t, d***} belonging to ***E***
Events ***e'*** = {***a, cn, fn, t, d***} belonging to ***E'***

Where each ***e*** represents a specific note: if ***e*** represents a note of Pattern A and if ***e'*** represents a note of pattern **B.**

Predicative-Aggregative formalization of the first section

First part

i = iteration of the pattern
The note *a* is the base pitch that in ***e*** is *E* and in ***e'*** is *D*

Set of applications ***A***
e = {*a, cn = (12 x(i-1)), fn = 8 + (12 x(i-1)), free, mp*}
e' = {*a + ((¼ Tone) x (accumulated phase/120)), cn = 4+(8 x(i-1)) + 1 (accumulated phase /120), fn =* cn_i *+ 5-(i-1), free, mp*}

Second part

nb = note base that begins the part in eighth notes
Set of applications ***A***
e = {*a, cn = nb + (12 x(i-1)), fn =* cn_i *+ 8, free, mp*}
e' = {*a+((¼ Tone) x (accumulated phase /120)), cn = 4 + (8 x(i-1)) + 1 (accumulated phase /120), fn =* cn_i *+ 6-(i-1), free, mp*}

Third part

Set of applications ***A***
Durations here refer to the length of the Pattern A nd not to specific notes.

e = {a + ((¼ Tone) x (accumulated phase /120)), cn = nb + (6 x(i-1)), fn = cn_i *+ 6, free, mp}*
e' = {a - ((¼ Tone) x (accumulated phase /120)), cn = nb + 2 (8 x(i-1)) + 1 (accumulated phase/120), fn = cn_i *+ 6, free, mp}*

Fourth part

Set of applications ***A***
Durations here refer to the length of the Pattern A nd not to specific notes.
e = {a + ((¼ Tone) x (accumulated phase/120)), cn = nb + (6 x(i-1)), fn = cn_i *+ 6, free, mp}*
e' = {a + ((¼ Tone) x (accumulated phase/120)), cn = nb + 2 (8 x(i-1)) + 1 (accumulated phase/120), fn = cn_i *+ 6, free, mp}*

Predicative-Aggregative formalization of the third section

Reference systems

Pattern A *= {pitch, beginning of the note, end of the note, timbre, dynamics}*
Pattern B *= {pitch, beginning of the note, end of the note, timbre, dynamics}*
Set of events of ***E*** = {***e***, ***e_1***,...} belonging to the ***Pattern A***
Set of events of ***E'*** = {***e'***, ***e'_1***,...} belonging to ***pattern B***

Where each ***e*** represents a concrete note if ***e*** represents a note from ***Pattern A*** and if ***e'*** represents a note from ***pattern B***.
nb is equal to base note (i.e., the beginning of the note that begins the section that applies this formalization)
The dynamics are formalized as:
1 = *pppp*
2 = *ppp*
3 =*pp*
7 =*f*
10 =*fff*

First part

e = {a, nb = 1 + (6 x (i - 1)), 5 + (6 x (i- 1)), free,(i + 1)}
e' = {a + ((¼ Tone) x (30 cumulative out of phase)) + [1,0, - 1, -2] (to be added one of these quantities by election), nb +(i x17), nb+7 + (i x 17), free,(i +9)-1}

Second part

The timbre is formalized in a relative and less strict manner in which 10 corresponds to noise and 0 corresponds to a noise-free timbre.

e_i *= {a = (nb if i=1 or e{*a_{i-1}*} + (¼ Tone) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i =1 o e{*cn_{i-1}*} + 13 –i), fn = (e {*cn_i*} + 8 - 0.5i), t = 11-i, d = 11-i}*

e'_i *= {a = (nb if i = 1 or e {*a_{i-1}*} + ((¼ Tone) x (phase/30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb if i = 1 or e{*cn_{i-1}*} + 9 +i), fn = (e {*cn_i*} + 8 + 0.5i), t = i, d = i}*

Third part

e_i = {a = (nb if i = 1 or e {a_{i-1}} + ((¼ Tone) x (out of phase/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +i-1), fn = (e {cn_i} + 8 + 0.5i), free, d = i}

e'_i = {a = (nb if i = 1 or e {a_{i-1}} + ((¼ Tone) x (phase/30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +18-i), fn = (e {cn_i} + 16 - 1i), free, d = 8-i}

Fourth part

e_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i =1 or e{cn_{i-1}} +i-1), fn = (e {cn_i} + 8 + 0.5i), free, d = i+1}

e'_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (phase/30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb if i =1 or e{cn_{i-1}} +18-i), fn = (e {cn_i} + 16 - 1i), t = i, d = 10+i }

Predicative-Aggregative formalization of the fifth section

First part fifth section

e_i = {a = (nb if i = 1 or e {a_{i-1}} + ((¼ Tone) x (out of phase/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i =1 or e{cn_{i-1}} +14-i), fn = (e {cn_i} + 8.5 - 0.5i), free, d = 11-i[62]}

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[62] See exceptions that apply here in the analysis.

e'_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase/30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb+2 if i = 1 or e{cn_{i-1}} +11-i), fn = (e {cn_i} + 6.5 - 1i), free, d = 5}

Second part fifth section

The out phase against ***W***, which is an imaginary pattern that lasts twelve eighth notes, is introduced in this part.

e_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase with respect to W/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +14-i), fn = (e {cn_i} + 4.5 + 0.5i), free, i + 2}

e'_i = {a = (nb if i = 1 or e {a_{i-1}} + ((¼ Tone) x (out of phase with respect to W 30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb+2 if i = 1 or e{cn_{i-1}} +5+i), fn = (e {cn_i} + 10.5 - 0.5i), free, i +2}

Third part fifth section

e_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase with respect to W/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i =1 or e{cn_{i-1}} +13-i), fn = (e {cn_i} + 13-i), free, p-mf }

e'_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase with respect to W 30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn = (nb+2 if i =1 or e{cn_{i-1}} +6+i), fn = (e {cn_i} + 5, 5 + i), free, p-mf }

Fourth part fifth section

e_i = {a = (nb if i = 1 or e {a_{i-1}}-+ ((¼ Tone) x (out of phase with respect to W 30)) + [0,1,2,3](to be added one of these quantities by election)), cn = (nb+2 if i = 1 o e{cn_{i-1}} +4+i), fn = (e {cn_i} + 4 + i), free, free}

e'_i = {a = (nb if i = 1 or e {a_{i-1}} - ((¼ Tone) x (out of phase with respect to W/30)) + [0,1,2,3,4](to be added one of these quantities by election)), cn =(nb if i = 1 or e{cn_{i-1}} +12-i), fn = (e {cn_i} + 11.5 - i),free, free}

Predicative-Aggregative formalization of the seventh section

First part seventh section

Given that we use the last note of the note scheme as a reference of the increase in pitch for the first time, we will call the last note of the note scheme based on the previous iteration l a_{i-1}^{u}.

E_i = {a = (nb if i = 1 or e {a_{i-1}} - ((½ Tone) x (out of phase with respect to W/30)) + [0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +6-i), fn = (e {cn_i} + 5 - i), free, 11-i}

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) +((¼Tone) (out of phase with respect to W/30) x) + [(0,1,2](to be added one of these quantities by election)), cn = (nb+2 if i = 1 or e{cn_{i-1}} +13-i), fn = (e {cn_i} + 11 - i), free, 1-i}

Second part seventh section

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) + ((½ Tone) x (out of phase with respect to W/30)) + [(0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +12-i), fn = (e {cn_i} + 12 - i), free, mp-p}

e_i = {a = (nb if i=1 or e{a_{i-1}^{u}}) - ((¼ Tone) x (out of phase with respect to W/30)) + [(0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +4 +i), fn = (e {cn_i} + 4 + i), free, mp-p}

Third part seventh section

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) + ((½ Tone) x (out of phase with respect to W/30)) + [(0,1,2](to be added one of these quantities by election in quarter tones),cn = (nb if i = 1 or e{cn_{i-1}} +4 +i), fn = (e {cn_i} + 4 + i), free, mp-ff}

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) - ((½ Tone) x (out of phase with respect to W/30)) + [(0,1,2](to be added one of these quantities by election)), cn = (nb if i = 1 or e{cn_{i-1}} +12-i), fn = (e {cn_i} + 12 - i), free, mp-ff}

Forth part seventh section

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) - ((½ Tone) x (out of phase with respect to W/30)) + [(0,1,2](to be added one of these quantities by election in quarter tones)), cn = (nb if i = 1 or e{cn_{i-1}} +4 +i), fn = (e {cn_i} + 4 + i), free, 11-i}

e_i = {a = (nb if i = 1 or e{a_{i-1}^{u}}) +((½ Tone) x (out of phase with respect to W/30)) + [(0,1,2(to be added one of these quantities by election in quarter tones)), cn = (nb if i = 1 or e{cn_{i-1}} +3 +i), fn = (e {cn_i} + 3 + i), free, 11-i}

When *i* = 5 juxtapose the same iteration (only once) and continue without increasing *i.*

Schemes of the work

Section 1			
1–8	9–17	18–24	25–32
A (cb, ***pno***, perc)	A (vl1, ***pno***, vla)	A (***per***, vl1, vl2)	A (***per***, pno, vcl)
B (vl1, vl2, vla, vcl)	B (per, vl2, ***vcl***, cb)	B (pno, vla, ***vcl***, cb)	B (vl1, vl2, vla, cb)

Section 3			
A (***pno***, perc, vl1)	A (vcl, ***pno***, cb)	A (***per***, vl1, cb)	A (***per***, pno, vla)
B (vl2, vla, vcl, cb)	B (perc, vl1, vl2, **vla**)	B *(*pno, vl2, **vla**, vcl)	B (vl1, vl2, vcl, cb)

Section 5			
A (***pno***, perc, cb1)	A (***pno,*** vl1, vl2)	A (***per***, vla, vcl)	A (***per***, pno, cb)
B *(*vl1, vl2, vla, vcl)	B (perc, vla, vcl, **cb**)	B (pno, vl1, vl2,**cb**)	B (vl1, vl2, vla, vcl)

Section 7			
A (***pno***, perc, vl2)	A (***pno***, vl2, cb)	A (***pno***, vla, vl2)	A (vl1, vl2, vla)
B (vl1, vla, vcl, cb)	B (perc, vl1, vla, ***vcl***)	B (perc, vl1, ***vcl,*** cb)	B (per, ***pno,*** cb, vcl)

Section 1			
a1	(a1)’	a2	(a2)’
A Duration: always the same length. 6 quarter notes, repeated 5 times Pitches: neutralized in *E* Dynamics: neutralized in *mp* Timbre: cognitive function	**A** Duration: always the same. Repeated 5 times Pitches: neutralized in *E* Dynamics: neutralized in *mp* Timbre: cognitive function	**A** Duration: always the same. 3 quarter notes, repeated 9 times Pitches: begin to ascend from *E* using a cumulative phase Dynamics: neutralized in *mp* Timbre: free	**A** Duration: always the same. 3 quarter notes, repeated 9 times Pitches: continue descending using a cumulative phase Dynamics: neutralized in *mp* Timbre: free
B Duration: always the same pattern. 4 quarter notes but decreases an eighth note per iteration. Repeated 6 times Pitches: decrease ¼ tone by 30 degrees Dynamics: neutralized in *mp* Timbre: cognitive function	**B** Duration: always the same pattern duration but the note duration decreases an eighth note per iteration Pitches: decrease ¼ tone by 30 degrees Dynamics: neutralized in *mp* Timbre: cognitive function	**B** Duration: the pattern durations are always equal. Repeated 9 times Pitches: decrease ¼ tone by 30 degrees Dynamics: neutralized in *mp* Timbre: free	**B** Duration: the pattern durations are always equal. Repeated 9 times Pitches: decrease ¼ tone by 30 degrees Dynamics: neutralized in *mp* Timbre: free Note scheme changes from 4 to 5 notes

Section 3			
a3	a4	(a4)$^{-1}$	(a3)’
A Duration: always the same. 6 quarter notes. Pitches: neutralized Dynamics: increase in each iteration Timbre: cognitive function	**A** Duration: an eighth note is increased in each iteration (from 3 to 11). Total of 8 iterations Pitches: decrease ¼ tone by 30 degrees Dynamics: go from *f* to *PPP,* decreasing a grade per iteration with gradations Timbre: neutralized harmonic evolving to overpressure	**A** Duration: an eighth note is increased in each iteration (from 11 to 3). Total of 8 iterations Pitches: increase a ¼ tone by 30 degrees Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations Timbre strings: normal to overpressure, increasing a degree per iteration; CB is same but from harmonic to harmonic with overpressure; perc free	**A** Duration: begins at 1 eighth note and increases at a rate of eighth note per iteration Pitches: decrease ¼ tone by 30 degrees Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations Timbre: neutralized (see exceptions)
B Duration: begins with 16 eighth notes, decreasing an eighth note per iteration Dynamics: start at *ppp* and diminish a degree per iteration Pitches: decrease ¼ tone by 30 degrees Timbre: each degree decreases and becomes normal noise	**B** Duration: increases an eighth note in each iteration of 11 to 16 (6 iterations) Pitches: decrease ¼ tone by 30 degrees Dynamics: from *ppp* to *f,* increasing a degree per iteration with gradations Timbre morphing: overpressure to *Cl. Batt.* a grade per iteration	**B** Duration: decreases a eighth note in each iteration of 16 up to 11 (6 iterations) Pitches: increase ¼ tone by 30 degrees Dynamics: from *f* to *PPP,* declining a grade per iteration with gradations Timbre: the same elements as in *a4* but distributed more freely	**B** Duration: begins with 10 eighth notes and increases at a rate of eighth note per iteration Pitches: increase ¼ tone by 30 degrees Timbre: neutralized Dynamics: range from *pppp* to *ffff, increasing* a degree per iteration with gradations (see exceptions)

Section 5			
(a1)“	((a1)“)’	a5	(a5)’
A Duration: begins with 12 eighth notes, decreasing an eighth note per iteration Pitches: increase ¼ tone by 30 degrees Dynamics: neutralized to *mp* Pitches: increase ¼ tone by 30 degrees of lag Timbre: free, similar to *a1*	**A** Duration: an eighth note is increased in each iteration (from 7 to 12) Pitches: decrease ¼ tone by 30 degrees Dynamics: *pp* to *f*, increases a grade per iteration Timbre: increasing harmonic overpressure by degree of iteration	**A** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: decrease ¼ tone by 30 degrees Dynamics: between *mp* and *mf* Timbre: string CL. Batt bowed string piano and CL. Tratto	**A** Duration: starts at 1 eighth note and increases at a rate of beams per iteration Pitches: decrease ¼ tone by 30 degrees Dynamics: range from *pppp* to *ffff, increasing* a degree per iteration with gradations Timbre: neutralized Dynamics: range from *pppp* to *ffff, increasing* a degree per iteration with gradations (see exceptions)
B Duration: begins with 9 eighth notes, decreases by an eighth note per iteration, finishing in 1 Dynamics: neutralized in *mp* Pitches: decrease ¼ tone by 30 degrees of lag Timbre: free, similar to *a1*	**B** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: decrease a ¼ tone by 30 degrees Dynamics: from *pp* to *f,f* to increasing a grade per iteration Timbre: increasing harmonic overpressure by degree of iteration	**B** Duration: an eighth note is increased in each iteration (from 7 to 12) Pitches: decrease a ¼ tone by 30 degrees. Dynamics: between *mp* and *mf* Timbre: CL. Batt and harmonics to evolve to overpressure; perc. cymbal with bow	**B** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: increase a ¼ tone by 30 degrees Timbre: neutralized Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations (see exceptions)

Section 7			
(a3)“	((a5)’)’	((a5)’)’’	((a3)’’)’’
A Duration: from 12 eighth notes, decreasing an eighth note per iteration Dynamics: neutralized to *mp* Pitches: increase a ¼ tone by 30 degrees Timbre: free, similar to *a1*	**A** Duration: an eighth note is increased in each iteration (from 7 to 12) Pitches: decrease a ¼ tone by 30 degrees Dynamics: from *pp* to *ff*, increasing a grade per iteration Timbre: increasing harmonic overpressure by degree of iteration	**A** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: decrease a ¼ tone by 30 degrees Dynamics: between *mp* and *mf* Timbre: string *Cl. Batt.*, bowed string, piano, and cl tratto	**A** Duration: begins with 1 eighth note and increases one per iteration Pitches: decrease a ¼ tone by 30 degrees Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations Timbre: neutralized Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations (see exceptions)
B Duration: begins with 9 eighth notes, decreases at the rate of an eighth note per iteration, finishing with 1 Pitches: decrease a ¼ tone by 30 degrees Dynamics: neutralized in *mp* Timbre: free, similar to *a1*	**B** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: decrease a ¼ tone by 30 degrees Dynamics: from *pp* to *ff*, increasing a grade per iteration Timbre: increasing harmonic overpressure by degree of iteration	**B** Duration: an eighth note is increased in each iteration (from 7 to 12) Pitches: decrease a ¼ tone by 30 degrees Dynamics: between *mp* and *mf.* Timbre: CL. Batt. and harmonics evolve to overpressure; perc. cymbal with bow	**B** Duration: an eighth note is diminished in each iteration (from 12 to 7) Pitches: decrease a ¼ tone by 30 degrees Timbre: neutralized Dynamics: range from *pppp* to *ffff,* increasing a degree per iteration with gradations (see exceptions)

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8. Characterization and modelization of cognitive-parametric music

Characterize does not mean to define. As I have already mentioned at the beginning of the book, I do not pretend to normalize these standards or rules, but rather to explain their establishment and seek further understanding of their uses. I will now convey the features that characterize cognitive-parametric music without providing a standard definition. Through my work in this text, I simply aim to open up the field to future creations by describing what they are from an empirical standpoint.

The fundamental characteristics of cognitive-parametric music are:

1. Uses the parameter concept as sound material.
2. Avoids the establishment of any element as central in the work.
3. Facilitates listening through ambiguity, as well as the multiple meanings of materials through strategies that allow for a relativity of listening.
4. Replaces the concept of dissonance associated with material properties with the dissonance associated with cognitive processes (cognitive dissonance). Also replaces sound flow stress based on stress-relax processes associated with a parameter (either the density or the pitches) by a cognitive process derived from cognitive tensions caused by the abstraction of materials. The abstraction is obtained from the absence of a parametric center.
5. Establishes the multivalent principle of sound flow order through settling fact using cognitive models.

6. Derives formal thought from a mobile system of interrelation and inter-definition between the considered parameters.
7. Establishes forms of inter-definition of parameters through integrational cognitive models, gestural models, psychoacoustic models, or a correlation of signification spaces strategies.
8. Defines the form as a structure that establishes a relationship between the parameters in a continuous evolution. The way in which the parameters interact is mobile throughout the work.
9. Reduces the concept of traditional material to a minimum. In its place, the parameters, as sound material, are understood as a model that takes center stage and integrates all the parameters through a formally structured changing relationship (first studies) or by formalizing them structurally (third study).
10. Defines and characterizes each parametric composition by a signification space, which assigns a changing meaning to each difference of a sound property throughout the work according to the formal scheme or time.

The fundamental techniques of cognitive-parametric music are:

1. Parametric neutralization
2. Parametric modulation
3. Parametric formalization involving a parametric inter-definition (not all formalizations are worth)
4. Parametric inter-definition through the correlation of the signification space.
5. Parametric inter-definition through cognitive-perceptive or electroacoustic models
6. Establishment of settling facts through pattern recognition strategies
7. Establishment of settling facts through cognitive, perceptual, gestural, or psychoacoustic strategies
8. Integrational cognitive models that modelize the way in which the perception of a few parameters influences the perception of others
9. Establishment of rotary determination flows through gestural strategies, and/or cognitive, electro-acoustic, and psychoacoustic models.
10. Objects are rendered meaningless through the functional multivaluing of the multiple ways in which a sound object can be significant.

11. Establishment of determination flows through cognitive models.

Parametric Neutralizations Studies	**Parametric Modulations Studies**	**Parametric Formalizations Studies**
A formal definition of parametric neutralization, which is applied simultaneously to all parameters.	Improved and extensive use of parametric modulations.	Use of a formalization of the concept of the relativity of temporality perception.
Gestural strategies to establish cognition of determination flows.	Use of the parametric inter-definition through the signification space by induction.	Inter-definition of time through an integrational cognitive model between movement and memory. (Integration of Grisey's and Feldman's cognitive rules.)
Use of basic parametric modulations (entropic).	Meaningless of objects as multivaluing.	Modeling of the idea of the Doppler effect.
Use of gestural cognitive models and gestural settling facts.	Settling facts defined on pattern recognition-based cognitive models.	Use of cognitive models that relate the current memory window with the perception of temporality.
Parametric neutralizations, entropic parametric modulation, parametric themes, parametric scales, parametric delays, parametric melodies, parametric inversions.	All of the previous ones plus: parametric modulation by parametric inter-definition, parametric scales, parametric tonalities, parametric serialism, parametric transpositions.	All used in two previous studies.

Modelization of a cognitive-parametric work

A parametric musical work consists of four main components, each of which are defined as a set.

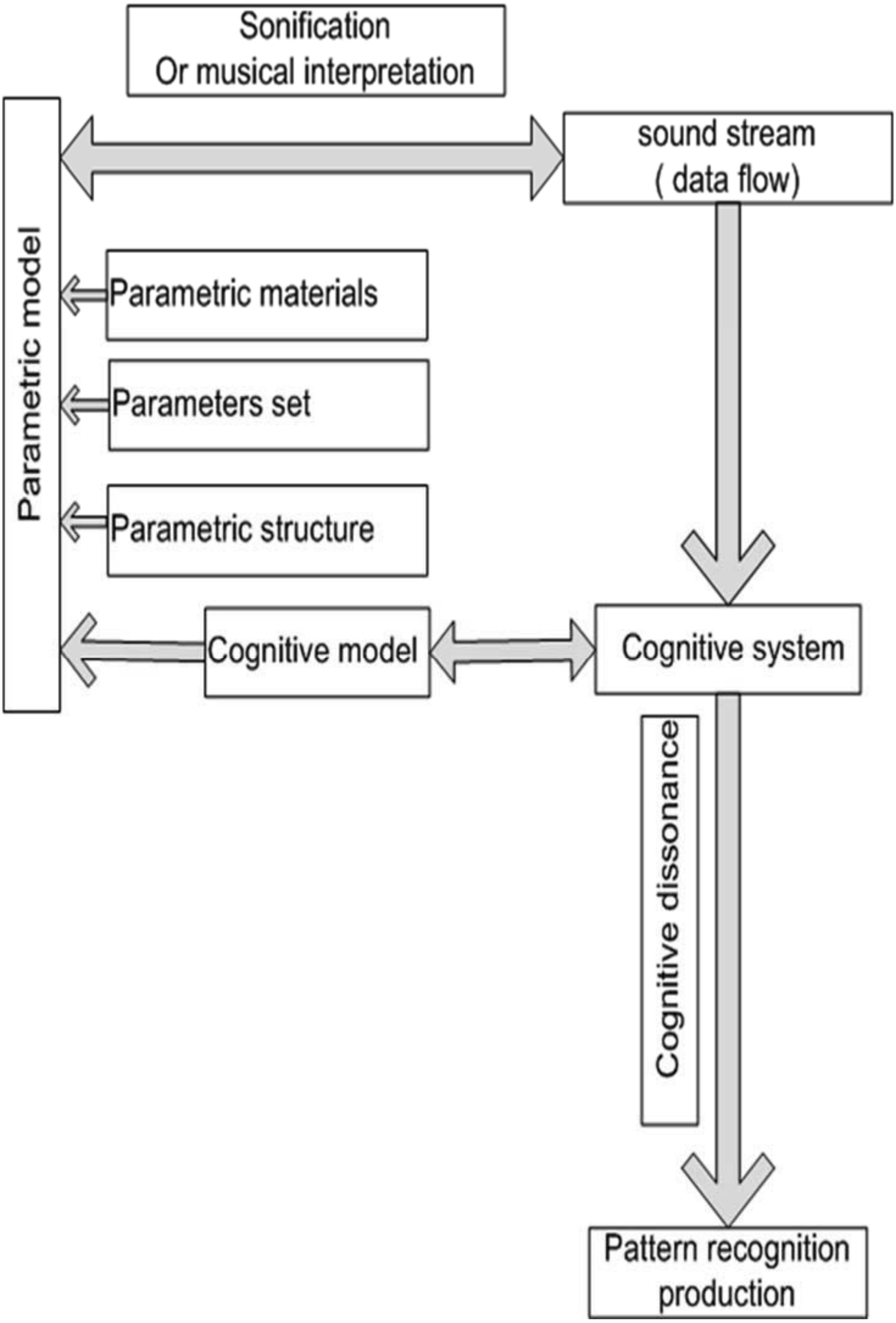
The parametric structure defines the strategy for determining a central parameter.

A set of cognitive models defines how the listening cognitive system will perceive the work and how cognitive tensions are produced.
Furthermore, the integrational models specify how one parameter influences the perception of another one.

A set of parametric materials defines the parametric materials that will be used.

A set of parameters defines the kind of parameters that will be used or modelized in the work. Each parametric work has its own musical concept that requires an optimal parameterization of the musical objects, i.e., the best suites for the work concept.

Work	**Cognitive dissonance**	**Parametric Formalizations Studies**	**Parametric Modulations Studies**
Parametric structure	Formalization of the relativity and temporality of perception.	Formalization of the relativity and temporality of perception.	Rotative system of parametric modulations.
Cognitive models	Several models to generate cognitive dissonance based on integrational models. Perceived pace model of James.	Integrational model of movement and memory. Perceived pace model of James. Modelization of the Doppler effect.	Differential asymmetries in the distribution curves of probabilities in the set of considered parameters. Use of parametric inter-definition through the spatial signification by induction.
Parametric materials	Parametric formalization.	Parametric formalization.	Parametric modulations, parametric tonality, parametric serialism, parametric scales, parametric cadences.
Parameter set	{Pitch, beginning of the note, end of the note, timbre, dynamics, envelope, cutoff-filter, stereo position}	{Pitch, beginning of the note, end of the note, timbre, dynamics}	{Pitch, duration, timbre, dynamics}


Sonification
Or musical interpretation
sound stream
(data flow)
Parametric model
Parametric materials
Parameters set
Parametric structure
Cognitive model
Cognitive system
Cognitive dissonance
Pattern recognition
production

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Glossary

Cognitive dissonance. A cognitive dissonance occurs when the brain has established a specific criterion for the order of elements, but then an element, which was not the expected one according to the cognitive principle deduced by the cognitive systems, appears unexpectedly. In my music, cognitive dissonances replace traditional dissonances, and the flow of tension and relaxation occurs through the increase or decrease of objects that create cognitive dissonance. See the text for more information (pages 53, 178).

Cognitive model. A **model** is a simplified representation of a studied phenomenon. More precisely, we can say that a model τ is an interpretation of a theory T if and only if all the statements of T are real in τ. If we have a theory about a certain cognitive phenomenon, a model is, therefore, an interpretation of that theory; therefore, cognitive model is a model of a cognitive theory. Thus, by starting from a cognitive theory, we can create a model that is an interpretation of this theory in order to satisfy our creative concerns in some way or another. But a cognitive model can also be used less precisely as a scheme that describes the interaction of several items within a system. In this way, instead of a theory that establishes the interaction of these items in such a system, we can take a model based on the rules of this theory so that everything the model says is compatible with the theory. For instance, we can take a series of cognitive rules drawn from cognitive science and establish a valid model to apply in our own work.
We can also take a model, change it, and apply this changed version to our work. I use the word model in all these ways, depending on the context.

Determination flows. A determination flow is when something determines another thing in a certain direction. For example, classical Marxism argues that infrastructures determine the superstructure, which establishes a determination flow between infrastructure and superstructure.

There are certain fields of knowledge where determination flows are fixed and others where they are mobile and can be inverted. Within some sociological theories, for example, certain historical moments may be established within certain determination flows inversed by historical causes.

Determination flows are associated with the problems of implication and causality. There are fixed determination flows that occur when something is the cause of an effect, meaning that the cause will always determine this effect. Mobile determination flows occur when two elements are related in a more open manner, and any of them can be determined by the other one or by a third determinant.

A reversal in a determination flow occurs when a certain element is no longer determined by the other one and becomes the determinant itself, which can cause cognitive dissonance.

Cognitive strategies can be used to establish the determination flows. For example, models of cognitive theories can set determination flows, or psychoacoustic models can control the way in which a parameter determines the threshold of perception of another. (This has been exploited in my electronic works, which I have hardly referenced in this text.)

Infinite series. A series defined by 12 notes by joint degrees. It must be symmetrical from several points of view, or act in a very neutral and meaningless manner. It used very often in my music since *End Game*. It has also been used in music by other composers, such as Ligeti's *Concerto for Cello*.

Integrational cognitive model. A cognitive model in which, in reference to a previous model, several items from the model are integrated in an interdependent relationship. For example, we may have a cognitive theory that stipulates that the perception of each one of the parameters is independent of the others and then create a consistent model that models the significant parameters of this theory.

However, we can also establish an interdependent relationship regarding how each one of the perceptions of a parameter determines the perception of the others, which is what we refer to as an integrational cognitive model. It can be said that this term is not necessary because a model can express infinite interdependencies between parameters. While this is certainly true, the purpose of using this adjective is to underline the difference between models that have an account in an explicit way and those that do not. This difference does not exist in the field of science but can be used to differentiate between formal modeling (when the relationship between parameters is not considered and each one is instead understood as isolated, as is the case in serialism) and naturalistic modeling (when parameter interaction is considered, as is the case in spectralism).

Listening conditioning. We say that a listener is conditioned when he expects a particular object to act in a certain way on the basis of what has just appeared. In tonal music, for example, the listener is conditioned to expect a resolution after a great dissonance, or to interpret a series of structures of the succession of chords as cadences. Behind each listening conditioning, there is a cognitive rule. More precisely, this foundation allows us to make an abstraction of this procedure and apply it more abstractly and systematically to other parameters.

Stravinsky was able to do this brilliantly when he generated a sound flow in which the rhythms had more importance in the sound discourse than the pitches. Thus, through frozen and detached from their function and significance, tonal harmonic structures (once neutralized) were able to create a conditioning of the rhythmic-based listening (albeit merely rhythmic and not in the perception of time). Stravinsky managed to displace the pitches by the rhythms as the settling parameter of the tensions and resolutions of the music stream. This process of abstraction is based on the idea that a piece consists of relaxations and tensions, but once you are able to change the parameter that defines the tensions, a whole new set of possibilities emerge. This is exemplified in Schoenberg's tune of timbres, where tension is produced by the timbral changes and later, like Xenakis, in his music of sound densities where the global density of events produces stress or strain. These parametric translations were the foundation of cognitive dissonance.

To abstract the concept of dissonance, use it without a tonal context, and apply it to any type of material, including psychological stress caused by the variation of the speed of the material, there are two types of listening conditioning: the historical and learned types of conditioning that are shared by one or several generations, and those that occur only inside the work itself.

I can't resist the temptation to quote Schoenberg in regard to the historical kind of conditioning of parallel octaves and fifths:[63]

> [O]ctaves and fifths were not bad in themselves bad, but on the contrary, were in themselves good; that they had merely come to be considered outmoded, primitive, relatively artless; that there was no physical nor aesthetic reason, however, why they should not on occasion still be used. And if one considers that these rules, in the form 'Thou shalt not . . .' were spread abroad over centuries, then it becomes clear that the ear forgot the sound once found to be euphonious, and its use aroused antagonism because of the oddness the new always has about it. I am saying that, since progression in parallel octaves and fifths was not practiced for centuries, the ear was disposed to regard the occasional appearance of such connections as new, as odd, whereas the opposite is always actually the case: they were old, only forgotten. (Schoenberg,[64] *Treaty of Harmony*, p. 68)

Thus, listening conditioning, which means interpreting certain sound objects as correct or incorrect and to place them before or after another, forms part of the establishment of a type of music as normative (or exceptional) for a time period. In addition, it reveals one of the reasons

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[63] Indeed, there is a way of to interpret the prohibition of the fifth and octave parallels from the perspective of cognitive-parametric music, which has to do with a material's loss of significance when it is repeated insistently. As we have seen several times, this leads to the material's neutralization. In the context of tonal music, the neutralization of the fifth or octave can have enormous negative consequences.

[64] I am going to pay homage to Schoenberg here, not only for being the creator of serialism, but because I would argue that he introduced many elements of modernity – some that are often forgotten – that make him the first composer, as far as I know, to justify a rule through a cognitive rule in his theoretical writings. He was also the first composer that consciously neutralized parameters to highlight others through his invention of the melody of timbres. He was the first composer who used parametric neutralization and was also an innovator in the use of vocal and instrumental techniques.

for the trends in the evolution of the material referred to by Adorno; when new relations among materials are created, the historical conditioning of these materials is lost, and with it the tremendous nuances associated with them.
And yet, listening conditioning may only have validity in a work where it is consciously inserted, as seen in cognitive-parametric music. See the analysis of *End Game* to more fully understand its application in a real context.

Listening positionality. The listening property of focusing on a particular type of element once the ability to recognize certain patterns is obtained. When we say that listening is positional and therefore relative, we mean that the listener has a directional component that is determined freely but normally revolves around a series of cognitive rules. Listening positionality determines the intentionality through which the information loads of the sound materials are interpreted and processes are focused upon by the listener. For example, this is what allows us, in a telephonic conversation with lots of noise, to differentiate between conversation and noise and ignore sounds that do not add information. It is the basis of the possibility of the signification space as applied to music. Information loads derived from the focus of listening in a certain process can be significant in one scenario, but not in another one.

Modeling. To create a structure based on a theory whose result is a model.
For example, we can model a musical work in many different ways and from different theories. We can also take the conglomerate structure formed by the listener, its cognitive system, and the parameterization of the work to create a model based on a theory that explains how the music works at the moment in which listening occurs.
Another example in regard to tonal music theory is the creation of a model for a work of art that only considers the significant parameters of this theory. We can also create a cognitive model that explains how we perceive the work by considering only these two parameters. For this

reason, such a cognitive model would be a model of tonal theory but not of integral serialism.

Settling fact. At an abstract level, a settling fact is an event that puts itself or any other thing else as central. A settling fact is what sets a principle of order on several elements. It can be either formal or informal. A formal one is when the ordering principle is explicit and normative, such as the establishment of the alphabetical order of all the words in a dictionary. An informal one is when some objects are sorted by unspecified criteria.

In music, a settling fact is a kind of material ordered in an implied manner to indicate that listening orders the rest of the sound objects in the same way within that particular material.

In music, a settling fact can be made unconscious to the listener following the most obvious cognitive rules (those that give rise to the most primitive music), i.e., using an implicit order of elements that are best suited to cognitive strategies of pattern recognition that occur in a “natural” way. It naturally takes place because a human being, by default, prefers what is more easily recognized, even if they do not know why it is so. In a context of "naturalness," it does not make sense to talk about settling fact since it is taken for granted. The meaning of this term and its usefulness emerges when we want to establish principles of order, as opposed to focusing on what music would best fit the pattern recognition or “naturalness.” An example would be if the musical moments of rest fall on strong dissonances. To achieve this, several inconsistencies between different fields of pattern recognition are thus created, as heard in *End Game*. In this way, it *does* make more sense to talk about settling facts in order to define a more ambiguous or difficult order to process.

I am not the inventor of the settling fact: Schoenberg already knew it, when he spoke of cognitive rules in regard to his harmonies. In the following quotation, he is speaking about the links between tonal chords:

> [T]hus, repetition will generally be avoided, except our aim which is to give to any chord an extraordinary significance. At present we can have this aim with one chord only, with the last degree, the one that gives the key. By repetition we will lend this chord prominence in our little phrases and thereby express the key, event fat present not very convincingly. The most practical arrangement for this repetition is simply to put this chord first and last; *because the first and last impressions leave the deepest imprint* [emphasis added]. (Schoenberg, Theory of Harmony, page 42)

This quote reveals how the master of masters established a musical rule based on a cognitive model.

You can object that the rule relied on an intuitive knowledge; that when Schoenberg wrote this, the basis of a neuronal founded cognitive science as we know it today did not yet exist as we know today. However, if anything can confirm cognitive science, it is the fact that almost all artists' intuitions were based on cognitive laws. For example, all the principles of visual recognition today that pertain to how the brain can reconstruct information from an apparently imperfect representation (pointillism). were accepted and anticipated by the Impressionists and Van Gogh. Only once they were well established could we begin to use the same rules differently from how they were created, which is why the concept of settling fact can now be employed. By relying on the foundations of cognitive science, the settling fact can be used to generate structures deliberately incompressible and to generate ambiguous inductions in order to produce cognitive dissonances.

Thus, a settling fact in music can be based on the intuitions present in traditional music or on the cognitive science that allows us to decode the order of musical objects and relations between its parameters in completely different ways. At the same time, however, we can go against cognitive laws to create cognitive dissonances by replacing the usual schemes of stress relaxation with systems based on moments in which all sound objects are recognizable and those in which cognitive dissonances occur. I think that the master of cognitive dissonance was Luigi Nono, who is, in some ways, the creator of cognitive-parametric music, since the incredible tension that is produced in his works is based on cognitive dissonance (at least, this is my interpretation). He was certainly ahead of the curve. I was trying to unravel the secrets of his *Fragment*e when I found several fragments that provided me with the key to cognitive-parametric music. One such secret was to see how his music works around the concept of cognitive dissonance, although he of course never thought about his compositions in these terms.

Settling not only means "placing": it also means, above all, "position," since all knowledge is relative to the position that one has with respect to what is known (see Sartre's *Being and Nothingness,* which argues that all knowledge is etic and positional). To settle the fact is to put a position in *stricto sensu*. After setting the position, a principle of order is determined.

Therefore, my music departs from nowhere to the extent that nothing is anything *a priori*: the positions are what generate the loads of sense. Just as ontological loads derive from an absence and lack of being according to Sartre, my music's cognitive intelligibility (loads of sense in the musical context) derive from the front of the listening position and what is heard setting through the settling fact.
The Settling fact is based on the idea that listening is intentional and positional, and that both, its intention as its position, can be conditioned musically.

Signification space. A semiotic function that assigns a significance to a certain value or objective difference in a parameter conditioned by another parameter. An example would be the colors associated with a physical spectrum, as each language associates a word with a range of visual spectrum in order to define them. Thus, if the continuous change in wavelength produces colors, at what time can we say that a brief increase is already a different color? This is what defines the signification space, which is more subjective than a physical space. The relativity of signification space is demonstrated in the language. It is curious that different systems have been created to describe the colors in different civilizations; if colors have great significance for survival, many different words are created to define those colors, whereas few words are created within systems where colors are not relevant. Thus, the signification space is a new space created as a consequence of an objective difference (the difference between two wavelengths) that assigns a relative and subjective meaning to this objective difference. This space can also vary over time or be a function over time; in other words, a certain difference may be important at one time, but unimportant at another (neutralized). The ability for a particular variation of a physical and objective parameter (the difference between two pitches) to suddenly have a certain importance in terms of time (the temporal development of the work) or in regard to another parameter (i.e., that the significance of a parameter is conditioned by another one) is very important in cognitive-parametric music. Thus, *Parametric Neutralizations Studies* is based on the idea that, in some moments, some parameters are neutralized and the physical objective differences do not mean anything, while at other times, these differences are extremely important. This allows the brain to encode and decode musical processes in certain ways, which leads to cognitive dissonances and produces tension in the work. In *Parametric Modulations Studies,* a common signification space of various parameters around another common element was created to allow modulations between various fragments.

Parameter. See page 97.

Parametric translation. The process through which the decisive parameter is changed in the interior of a system. In terms of the history of music, Stravinsky demonstrated how a tonal paradigm can change to a rhythmic one through a parametric translation, allowing the rhythms to remove the prominence of the pitches. A parametric work is characterized by the establishment of a sound discourse based on constant parametric translations; by the end of the work, it is revealed that none of the parameters were a dominating center.

Tautological time. A tautology is something that is absolutely true but does not bring forth any new information. There is no truer statement than saying *A* is *A*, but there is also no assertion less useful and meaningless. Thus, tautologies are meaningless: they do not say anything about reality. By tautological time, I mean certain moments in my music that can be read in so many different ways that they end up have no meaning at all. This is the intended consequence; the relativity of the listening encouraging everyone to use different strategies to decode and give meaning to such meaningless and subjective structures.

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